RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol. 64 JUNE, 1955 No. 6

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Endocardial Fibroelastosis: Roentgen Appearance[1]

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ENDOCARDIAL fibroelastosis (8, 36) is being recognized with increasing frequency and has now been described as a cause of cardiac failure and death in patients of all age groups (1, 3, 36). Other descriptive terms which have been used to designate this condition are "endocardial sclerosis" (2, 6, 9, 11), "endomyocardial fibroelastosis" (10, 17), "congenital fibroelastosis of the endocardium" (14), "fetal endocarditis" (16, 24, 32), "dilatation and hypertrophy of the heart" (23, 25, 35), "congenital diffuse endocardial hyperplasia" (28), "elastic tissue hyperplasia of the endocardium" (31), and "prenatal fibroelastosis" (32). It has been included, also, in the group of "primary myocardial diseases" (30). The significance of its recognition in the absence of any specific therapy (other than treatment directed toward cardiac failure in general) lies in the importance of distinguishing it from diseases which are amenable to surgery.

Fibroelastic change in the endocardium is variable in degree but will usually be recognized on gross inspection of the endocardial surfaces, which show shiny gray-white thickening that may extend to and involve the valves. The left side of the heart is most often affected, chiefly the ventricle, where the endocardial thickening is greatest over the septal surface. This tends to obscure the prominence of the trabeculae carneae. Less often, and to a lesser degree, the right side of the heart is involved, either additionally (5, 6, 17) or by itself. Cardiac hypertrophy and dilatation are usually quite marked.

The endocardial thickening is due to a heavy layer of elastic and collagen fibers which may extend into the myocardium for short distances about small blood vessels. No specific myocardial lesions are found, although changes ranging from patchy fibrosis to infarction have been described (6, 19, 20, 29, 34). Abnormal glycogen deposits are frequently present (19, 20, 29), and degenerative changes and calcifications are sometimes seen in muscle fibers underlying the thickened endocardium (8). The pericardium is normal in most cases. Pathologic changes in the lungs and other organs usually represent the effects of congestive heart failure. Mural thrombi, if present, may give rise to infarcts at distant sites.

Reconstruction of the pathogenesis and determination of the specific etiology or etiologic factors important in the production of this change in a given patient are often difficult. Frequently the same histologic pattern is found in patients with coronary artery arteriosclerosis (34) and medial necrosis of the coronary arteries

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(30). It is typically present in endocardium poorly nourished because of anomalies of the coronary circulation, such as origin of the left coronary from the pulmonary artery (6, 7, 13, 26, 34), and is found also in hearts which, as a result of some mechanical or structural defect or because of an excessively high load, are subject to abnormal stresses (6, 9, 14, 27). Oppenheimer (27) reports that of 5 patients with "adult type" coarctation dying in infancy, 4 had associated fibroelastosis; the fifth apparently died of pneumonia. Her review of the literature disclosed 14 similar cases, and in each instance in which the endocardium was described, it showed fibroelastosis. Bahn, Edwards, and DuShane (1) have also noted this association. DuShane and Edwards (9) and Stohr (33) have reported cases with associated aortic stenosis. Katz and Adams (21) describe a case with impaired ability to fabricate serum proteins. Kepler (22) recorded a case in a Kutchin Indian child with associated patent ductus.

Johnson (19, 20) feels that anoxia, frequently as the result of premature closure of the foramen ovale, is the key to the development of the endocardial change. However, the cases described in adults with normal coronary circulation (3, 4, 34) would appear to be the result of other factors. At any rate, interference with the blood flow through the arterioluminal channels (8, 11, 16), once the disease process has begun, would explain progress of the changes. Association with tuberous sclerosis, gargoylism, and dermatomyositis has been described (7); relationship to the collagen diseases has been proposed (18), and denied (34). Gross (16) reviewed the problem of etiology and concluded that there was no evidence for an intrauterine inflammatory origin of the disease; he credits Pototschnig (28) with first recording this discrepancy between the term "fetal endocarditis" and the microscopic findings. Most authors concur that the disease is of developmental origin, at least in infants and children.

Craig (6) found an associated extracardiac developmental abnormality in only 1 of his 37 cases and concluded that additional intracardiac abnormalities were seldom seen. Halliday (17), however, reported that 36 per cent of his patients had significant associated non-cardiovascular anomalies and that 57 per cent had cardiovascular anomalies in addition to fibroelastosis.

Weinberg and Himelfarb (36) have reported endocardial fibroelastosis in siblings, and one of our patients had a sibling who died of the disease. Greaves, Wilkins, and Pearson (15) report autopsy findings in identical twins and cite a personal communication from Carter mentioning an additional occurrence in siblings.

The clinical, roentgen, and electrocardiographic findings in our cases were similar to those described in the literature.

Clinically, the patients may come to the attention of a physician because of respiratory difficulties, various manifestations of cardiac failure, or discovery of cardiomegaly by physical or x-ray examination. Cyanosis is present only during cardiac failure.

Roentgen study shows a normal pulmonary circulation when the heart is compensated; when the left heart fails, the vessels are increased in prominence. The heart often appears globular in shape, particularly in infants; specific chamber enlargements are seen in older patients. Freer and Matheson (12) stress the occurrence of left auricular enlargement; this is probably of more prognostic importance, as indicating left ventricular failure, than of differential diagnostic value.

In all cases in which there was normal intraventricular conduction, the electrocardiogram displayed evidence of left ventricular hypertrophy. Two patients had anomalous atrioventricular conduction (Wolff-Parkinson-White syndrome), which made electrocardiographic detection of specific chamber enlargement impossible. One had, in addition, complete atrioventricular dissociation and Adams-Stokes attacks.

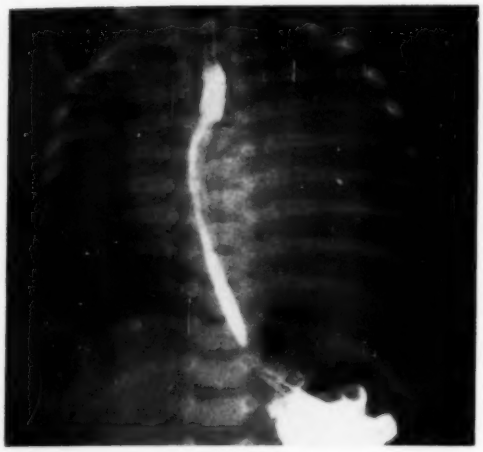


Fig. 1. Case I. Frontal film of the chest obtained at the age of three months, at a time when the patient was in failure, shows hyperaeration of the right lower lobe and some reduction in size of the right upper lobe, probably with pneumonitis. The huge globular heart hides most of the left lung so that it is difficult to assess the size of the pulmonary vessels. The left auricle displaces the esophagus.

Physiological studies, particularly heart catheterization, have been useful in our experience, in ruling out any of the potentially operable cardiovascular defects such as patent ductus arteriosus. Although there has been considerable variation in the degree of elevation of right-sided pressure, indicative of left ventricular failure, it would seem that such a finding might be expected to contribute to the prognosis in individual cases. Some correlation might be expected between heart size and pulmonary vascularity as demonstrated radiologically and elevation of pulmonary artery and right ventricular pressures. So far, not enough cases have been studied to determine this correlation.

CASE REPORTS

CASE I: P. Y., a three-month-old white infant, was brought into the hospital because of cough, rapid breathing, and intermittent cyanosis, which had their onset two weeks before. Films of the chest at the age of one month had shown enlargement of the heart.

Examination showed no cyanosis but a systolic murmur was heard all over the precordium. The lungs were clear, and the only evidence of failure was marked enlargement of the liver. An electrocardiogram revealed left ventricular hypertrophy. A film of the chest showed a huge globular heart (Fig. 1).

Therapy with digitalis and oxygen resulted in prompt regression of failure. The child died of cardiac failure at another hospital at the age of five months.

Postmortem Findings: The heart was large. When it was opened, the left ventricular endocardium was thickened, opaque, and white. The valves were normal, as were the coronary arteries. The ductus arteriosus was patent, although this was not considered a significant feature in this instance.

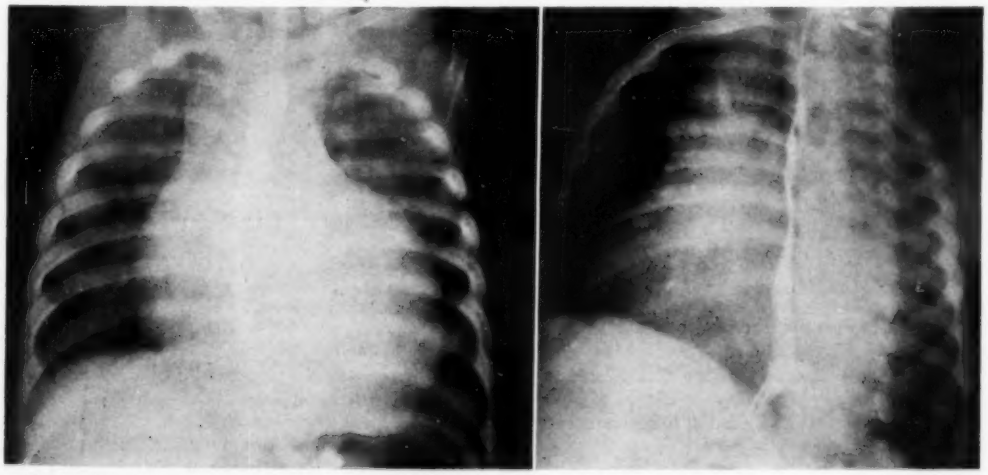
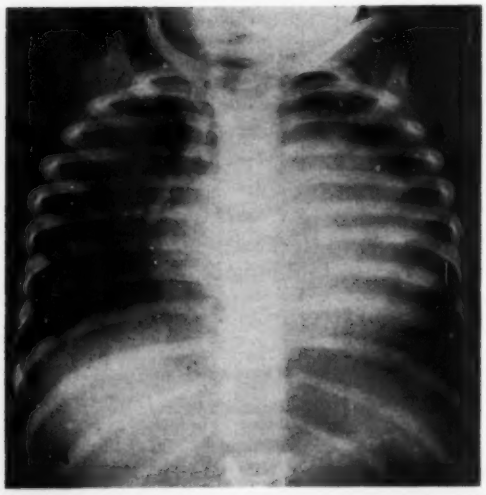


Fig. 2. Case II. Films made at the age of five months, when the child was not in failure. The frontal projection shows increased prominence of the pulmonary vessels in the upper lung fields. The diaphragm lies in normal position. The cardiovascular silhouette shows enlargement to both right and left, but in this case a well defined "vascular pedicle" is seen above the otherwise globular contour in contrast to some of the other cases. The oblique view shows both right and left heart enlarged.



the heart had previously been shown radiologically to be enlarged. Respiratory difficulty had been experienced since the age of three months; the thymus had been irradiated.

Examination revealed no evidence of cardiac murmur or cyanosis, although the heart was generally enlarged. The lungs and liver were normal. The pulse was 160; respirations 80 per minute. The electrocardiogram showed left ventricular hypertrophy. Cardiac catheterization was performed and disclosed no evidence of an intracardiac defect.

Films made at the age of five months (Fig. 2) show a globular contour, but a "vascular pedicle" is present.

The child died at the age of seven months of cardiac failure aggravated by a respiratory infection.

Autopsy Findings: Postmortem examination revealed cardiac hypertrophy and dilatation, predominantly left ventricular. The endocardium of the left ventricle, particularly over the interventricular sep-

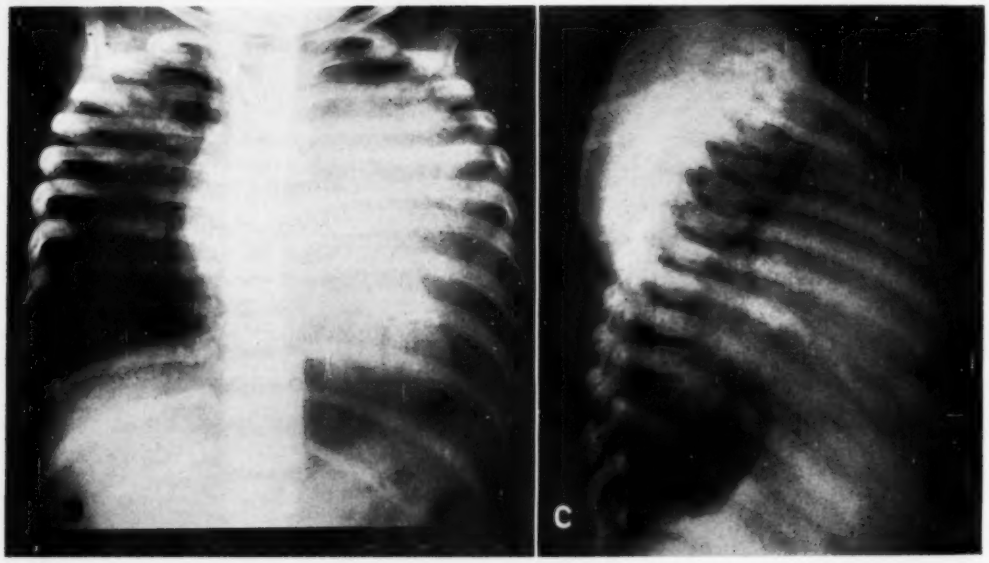


Fig. 3. Case III. A. Frontal projection obtained at the age of thirteen months, when compensation was good, showing normal pulmonary vascularity and normal lung volume. There is some collapse of the left lower lobe. The heart shows a globular contour with enlargement to right and left.
B and C. Films obtained at seventeen months, six days before death, showing further increase in the size of the heart, with a globular contour. Enlargement particularly toward the left side. There is also considerable posterior enlargement of the heart with increase in density and partial collapse of the left lower lobe. Pulmonary circulation is thought to be within normal limits.

The only other positive finding was bronchopneumonia.

Final Diagnosis: Endocardial fibroelastosis of the left ventricle.

CASE II: J. D., a white male, was brought to the hospital at the age of four and a half months because of diarrhea, which had been persistent for three days. There was no history of cyanosis, but

tum, was markedly thickened, up to 0.5 cm. The left ventricular wall was 8 mm. in thickness, and the right 3 mm. The foramen ovale was patent anatomically but not functionally. The valves appeared normal. The coronary arteries were normal. In the lungs were focal areas of atelectasis.

Microscopic sections of the left ventricle revealed a thickening of the endocardium due to elastic and collagenous connective tissue.

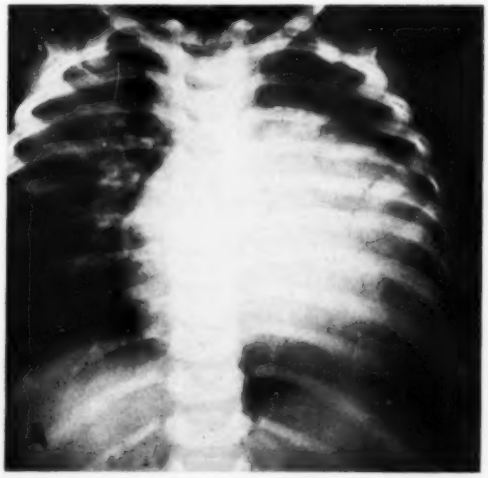
Final Diagnosis: Endocardial fibroelastosis of left ventricle.

CASE III: J. C., a thirteen-month-old colored female, was thought to be well until six weeks prior to admission, at which time her mother noted that the child was short of breath. A chest film was obtained at another hospital, showing enlargement of the heart and possible collapse of one lung.

The patient's temperature was 99.6°, pulse 85, respirations 20. The heart was not thought to be enlarged and there were no murmurs. No cyanosis was noted. The lungs were clear; there was no hepatomegaly or edema.

Cardiac catheterization showed only evidence of increased pressure in the right side of the heart. An electrocardiogram indicated left ventricular hypertrophy.

A frontal film of the chest at the age of thirteen months (Fig. 3A) showed a globular heart and normal lungs. At seventeen months (Fig. 3B), further cardiac enlargement was demonstrated, with some collapse of the left lower lobe. A lateral view (Fig. 3C) showed enlargement of both sides of the heart.



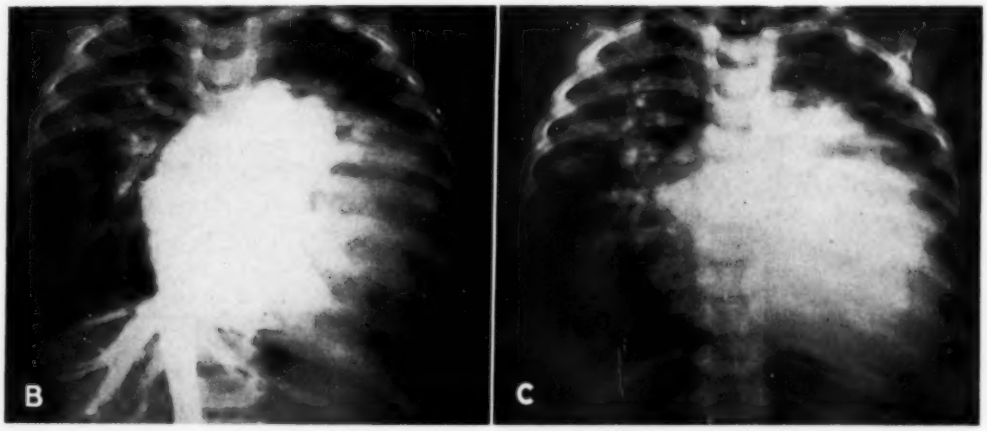


Fig. 4. Case IV. A. Film made at thirteen months, with the patient clinically in failure, showing increased prominence of pulmonary vessels. The diaphragm is in normal position. The heart is enlarged more to the left than to the right, but it presents a rounded contour on each side. The left ventricle is the largest chamber. The forward bulge of the right ventricle meets the chest wall, producing a contour against the anteromedial edge of the left lung.

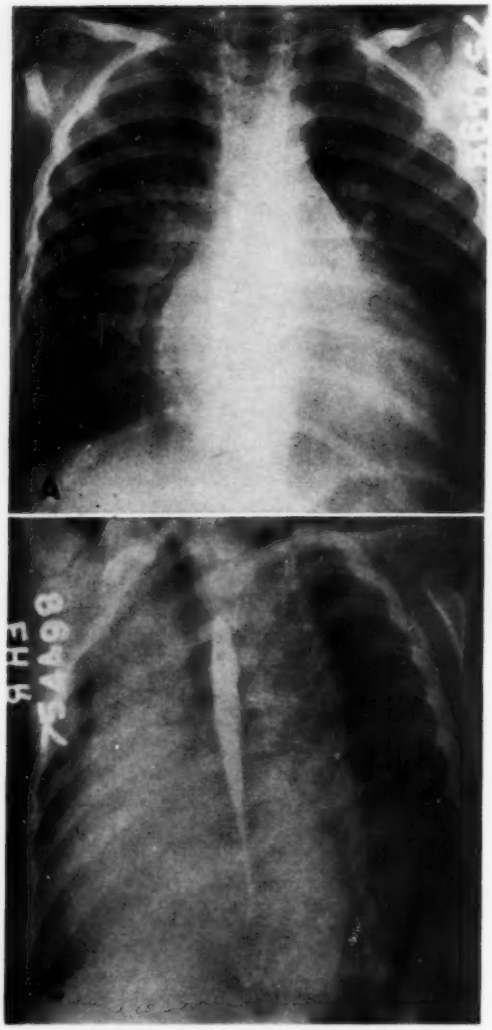
B. Angiocardiogram demonstrating filling of right auricle, right ventricle, and pulmonary vessels without evidence of shunt in either direction.

C. Later angiocardiogram showing the left auricle and huge left ventricle.

The patient died of cardiac failure at seventeen months in spite of therapy.

Autopsy Findings: The heart weighed 125 gm. (normal, 52 gm.) and showed marked hypertrophy. There were extensive thickening and fibrosis of the endocardium of both ventricles, but especially the left. A mural thrombus was present in the left ventricle, overlying the septum and posterior wall. The underlying myocardium showed no evidence of fibrosis. The pulmonary artery was considerably dilated, being about twice the size of the aorta. The coronary arteries were normal. The only other positive findings were chronic passive congestion of the lungs and liver and an old healed infarct in one of the kidneys.

Microscopic sections of both ventricles demonstrated a marked fibroelastic thickening of the endocardium involving many of the thin-walled veins in the underlying myocardium. The atria were uninvolved. There was organization of the adherent thrombus with focal calcification. The myocar-



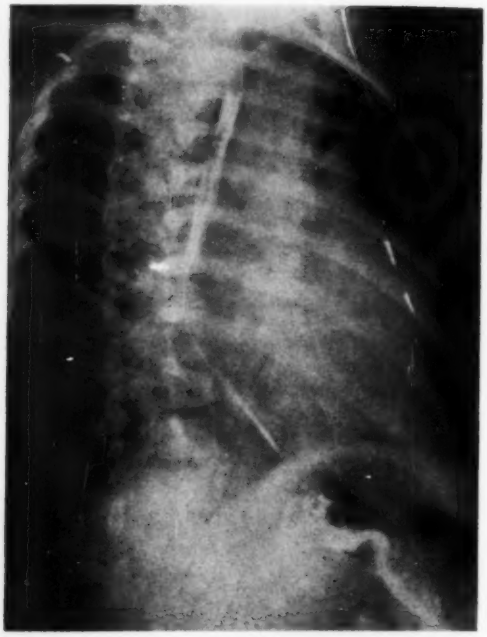


Fig. 5. Case V. Films of the chest obtained at twenty-eight months. At that time the patient had no clinical evidence of congestive failure.

A. Frontal view showing increased prominence of pulmonary vessels throughout. The fine horizontal lines of congestion are particularly well demonstrated along the lateral portion of the right lower lobe, adjacent to the chest wall. The heart showed generalized enlargement, the left ventricle being the largest chamber. The globular contour seen in some of the other patients is not observed here.

B and C. Left and right posterior oblique films showing enlargement of all chambers, with the left ventricle the largest.

dium also showed a patchy fibrosis, but no inflammatory reaction was present.

Final Diagnosis: (1) Endocardial fibroelastosis of both ventricles. (2) Mural thrombus, left ventricle.

CASE IV: L. T., a twelve-month-old white male, was admitted because of dyspnea for two weeks. The temperature was 100°, pulse 90, and respirations 36. The liver was not enlarged. No significant murmurs were heard. The heart was enlarged. There was no evidence of edema or cyanosis. The child was somewhat underdeveloped.

An electrocardiogram showed anomalous atrioventricular conduction (Wolff-Parkinson-White syndrome), so that the determination of single chamber enlargement was impossible. Cardiac catheterization revealed a high pulmonary artery oxygen, which could not be adequately explained. An angiocardiogram (Fig. 4) showed only evidence of right and left chamber enlargement.

Though the child appeared to tolerate the angiocardiographic procedure well, he died suddenly the same evening.

Autopsy Findings: The heart was globular and much enlarged, weighing approximately 120 gm. (normal, 44 gm.). All chambers were dilated and hypertrophied. The left ventricle showed the greatest enlargement; when it was opened, a dull whitish thickening of the inner surface was noted, particularly over the septum, where there were also flattening and obliteration of the trabeculae carneae. No endocardial changes were present in the atria or in the right ventricle. The thickness of the left ventricle was 1.2 cm. at the mid-portion; the right ventricle measured 0.3 cm. The valves were normal. The ductus arteriosus and foramen ovale were closed. The coronary arteries were normal. The lungs were heavy and congested.

Microscopic sections revealed the endocardium of the left ventricle to be greatly thickened by fibrous and elastic tissues. A sheath of such tissue was also seen to accompany the thebesian vessels into the myocardium. There was no evidence of myocardial fibrosis or inflammation.

Final Diagnosis: Endocardial fibroelastosis, left ventricle.

CASE V: C. J. G., a white female child of twenty-eight months, was brought to the hospital because of sudden onset of tachypnea associated with a respiratory infection and because a film of the chest at that time had shown cardiac enlargement. There was no past history of cyanosis, faulty development, or respiratory difficulty. A sister had died of fibroelastosis at the age of a year and a half.

Physical examination showed no cyanosis or edema. An apical systolic murmur raised the question of a mitral insufficiency. The heart was generally enlarged. The liver and spleen were not palpable. The cardiac rhythm was regular at 140. An electrocardiogram showed uncomplicated left ventricular hypertrophy. Cardiac catheterization revealed only evidence of right-sided hypertension resulting from the back-pressure of a failing left heart.

Films of the chest (Fig. 5) showed prominence of the pulmonary vessels and the fine horizontal lines of congestion in the lower lateral lung fields. The heart configuration indicated enlargement of all chambers, particularly the left ventricle.

The patient died of cardiac failure three weeks after admission.

Autopsy Findings: The heart was globular and greatly enlarged, weighing 150 gm. (normal, 85 gm.) and showing hypertrophy and dilatation of all four chambers, particularly the left ventricle. The pericardium was normal. There was whitish fibrous thickening of the endocardial surface of the posterior leaflet of the mitral valve and of the left atrium. On the right side only slight non-specific endocardial changes were noted. Measurements of the chamber walls were as follows: right ventricle, 2 to 3 mm., left ventricle, 10 mm., in thickness. The valves, except for the mitral, appeared normal, as did the coronary arteries. The lungs were congested and edematous.

Microscopic sections of the heart showed the endocardium of the left ventricle, and to a lesser degree of the left atrium, to be greatly thickened by elastic and fibrous tissue.

Final Diagnosis: Fibroelastosis of left ventricle, left atrium, and mitral valve.

CASE VI: C. G., a white female child, age twenty-nine months, had been in heart failure at seventeen months. She was subsequently maintained on digitoxin. She was brought to the hospital because of a respiratory infection and for evaluation of the heart.

Examination showed a pulse of 124 and respirations of 28 per minute. The child was poorly developed, but there was no evidence of cyanosis or edema. The heart was enlarged and there was a loud blowing systolic murmur. An electrocardiogram showed predominantly left ventricular hypertrophy.

Cardiac catheterization produced no evidence of shunt; it did show elevation of pressure in the right heart.

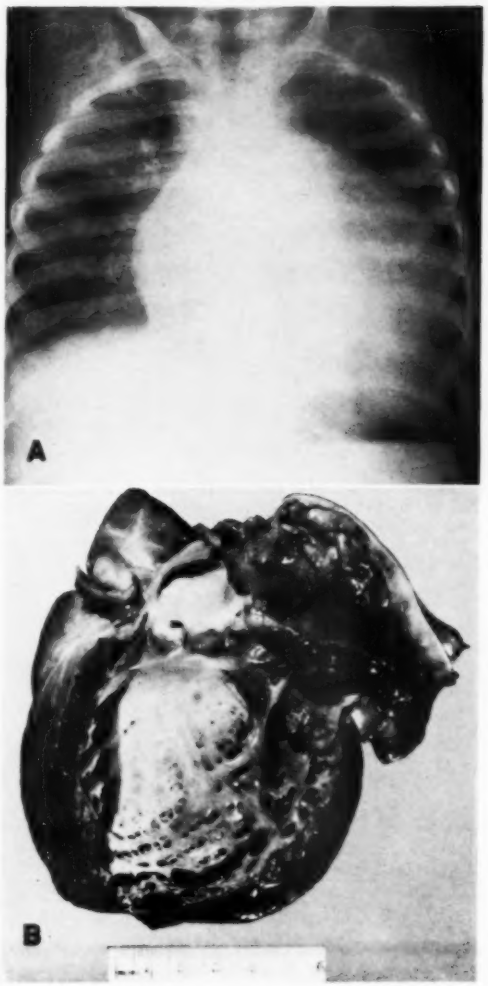


Fig. 6. Case VI. A. Frontal film at three years, when the child clinically was in congestive failure showing only slight prominence of the right lung root and no increase in prominence of the vascular shadows in the peripheral lung fields. The diaphragm is at normal height, with no evidence of increased lung volume. The heart is enlarged both to the right and to the left; it shows a globular contour. There is some density in the right cardiophrenic angle due to infarction.

B. Endocardial fibroelastosis of left ventricle, atrium, and mitral valve. Mural endocardium diffusely thickened, shiny, and opaque, obscuring papillary muscles and trabeculae carneae.

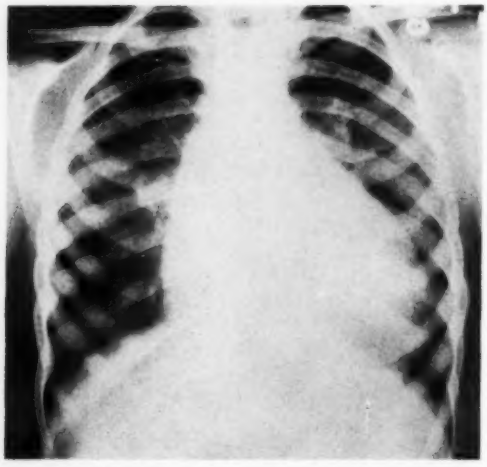


Fig. 7. Case VII. A frontal film of the chest obtained at the age of six years, when the patient was compensated. The diaphragm is low. The lung roots appear prominent, as do the vessels close to the roots, but the peripheral portions of the lung fields show normal pulmonary circulation. The heart is enlarged principally toward the left.

Films of the chest (Fig. 6A) made at the age of three years showed a globular heart. There was only slight prominence of the lung roots, though clinically the child was in failure.

There were subsequent admissions for cardiac failure, and death ensued at the age of thirty-eight months.

Autopsy Findings: The heart (Fig. 6B) weighed 230 gm. (normal, 88 gm.) and was uniformly hypertrophied and dilated. The endocardium of the left ventricle and atrium was thickened and gray in appearance. The muscular trabeculae were flattened. A large mural thrombus was present in the right ventricle. The wall of this chamber measured 1 to 1.4 cm. except at the tip, where there was a small aneurysmal bulging, with thinning of the wall to 1 mm. Muscular trabeculae were greatly hypertrophied. The left ventricle measured 1.5 cm. There was an irregular rolling and thickening of the edges of the mitral valve. The coronary vessels were normal. An old area of infarction was present in the right lower lobe.

Microscopic sections of the left ventricle and atrium showed a pronounced thickening of the endocardial layers due to the presence of elastic and collagen fibers. Periadventitial fibrosis about some branches of the coronary arteries was also noted.

Final Diagnosis: (1) Endocardial fibroelastosis, left atrium, ventricle, and mitral valve. (2) Focal endocardial fibrosis, right ventricle. (3) Mural thrombus, right ventricle.

CASE VII: D. B., a white male child, was first seen at the age of five and a half years because of attacks of fainting, cyanosis, and generalized convulsions since the age of one year.

Physical examination revealed a left precordial bulge and a Grade II systolic and diastolic murmur in the aortic area. Respirations were 24; pulse 32, with a complete A-V block. An electrocardiogram showed complete A-V dissociation, nodal rhythm, and left ventricular hypertrophy.

A frontal film (Fig. 7) demonstrated cardiac enlargement and some prominence of the lung roots, with clear lung fields peripherally.

The patient died at the age of six and a half years, probably during an Adams-Stokes attack.

Autopsy Findings: The heart weighed 240 gm. (normal, 100 gm.) and was enlarged in all diameters, being globular in shape. The endocardial surfaces of the left ventricle and atrium showed a dull grayish-white thickening, which on section measured up to 1 mm. in some areas. On the inner surfaces of the right ventricle and atrium there were only spotty areas of opacity. The heart valves all appeared normal. The right ventricle was 0.3 cm. thick, and the left 1 cm. The coronary vessels were normal. The only other changes were pulmonary congestion and edema and congestion of the liver and spleen.

Microscopic sections of the left side of the heart showed a diffuse thickening of the endocardium due to fibroelastic tissue. On the right side only minimal and focal fibrosis was seen. The myocardium was hypertrophied but without fibrosis or inflammation.

Final Diagnosis: Endocardial fibroelastosis of the left atrium and ventricle.

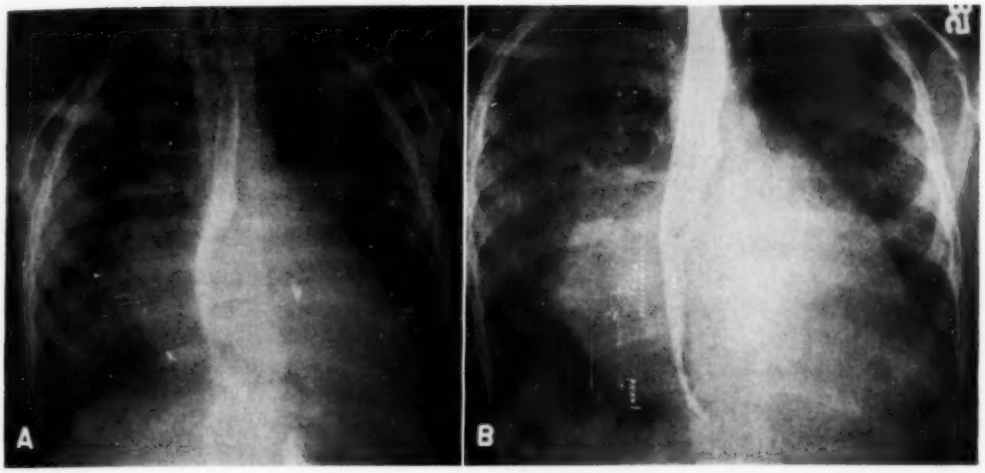
CASE VIII: D. P., a white female child of twenty-eight months, was known to have had a heart murmur since the age of one month. She had had no cyanosis, but development was delayed. She was brought to the hospital because of frequent respiratory infections.

Examination showed the heart to be grossly enlarged to the left. The liver was palpable; there was no cyanosis or edema. A very loud third heart sound was present, and a Grade IV systolic murmur, which was widely transmitted. The electrocardiogram showed left ventricular hypertrophy.

A film of the chest (Fig. 8A) showed enlargement of the left heart and prominence of pulmonary vessels. At six and three-quarters years (Fig. 8B) there was further increase in heart size and pulmonary vessels. An angiocardiogram (Fig. 8C) showed a very large left heart and no evidence of shunt.

Cardiac catheterization at the age of two revealed a left to right shunt and a diagnosis of patent ductus was made. Exploration by a posterior approach showed no ductus. Recatheterization was done at the age of four, and the shunt was found just above the semilunar valves. The defect was closed surgically, but the patient died of cardiac arrest.

Autopsy Findings: The heart weighed 200 gm. (normal, 100 gm.) and was generally hypertrophied.



The endocardium was normal in the right ventricle and atrium, but was extremely thickened throughout the left ventricle and the greatly dilated left atrium. The endocardial disease caused nodularity of the mitral valve and shortening of the chordae tendinae. The cusps of the pulmonary valve showed slight fibrous thickening. The thickness of the left ventricle was 1.5 to 2 cm.; of the right ventricle, 1.0 to 1.5 cm. Approximately 1 cm. from the pulmonary valve ring in the pulmonary artery was an aortic-pulmonary window 1.5 cm. in diameter. This had been surgically closed. There were areas of atelectasis in each lung.

Microscopic sections of the left ventricle and atrium showed marked thickening of the endocardium by abundant elastic and collagen fibers. Sections from the lungs revealed pulmonary arteriosclerosis. Although a mechanical defect existed, the endocardial changes were too extensive to be attributed to the effects of this alone.

Final Diagnosis: (1) Endocardial fibroelastosis of left ventricle, atrium, and mitral valve. (2) Aortic-pulmonary window.

CASE IX: M. W., a 29-year-old white housewife, had been well until two years prior to entry, when she began to experience dyspnea, palpitation, cough, and fatigue. She had had one pregnancy, with uneventful delivery seven years prior to admission. Her symptoms responded to therapy.

Examination showed no evidence of cyanosis, edema, or neck vein engorgement. The pulse was full but irregular at 70, and blood pressure was 100/70. The chest was clear; the heart was enlarged. There was a harsh systolic apical murmur transmitted to the axilla, and an apical rumbling diastolic murmur. The liver was palpable 6 cm. below the xiphoid. The electrocardiogram showed auricular fibrillation and evidence of left ventricular hypertrophy.

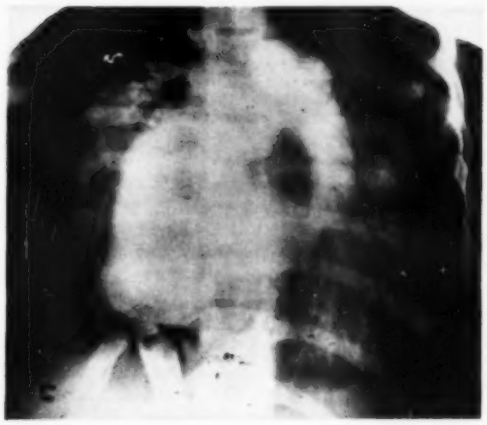


Fig. 8. Case VIII. A. Film of the chest obtained at the age of twenty-eight months, at a time when the patient was not in failure, showing the pulmonary vessels considerably increased in prominence. There is enlargement of both sides of the heart, with the left auricle and left ventricle the most markedly enlarged chambers.

B. Film of the chest obtained four and a half years after the initial films, and a week before death, showing persistence of the prominence of the pulmonary vessels throughout the lungs with atelectasis in the left lower lobe and a small amount of fluid in the right costophrenic angle. The left side of the heart is thought to be most markedly enlarged, with both left auricle and ventricle considerably increased in size.

C. A single film from an angiocardiographic series shows filling of right auricle, right ventricle, and pulmonary arteries. No evidence of the shunt is recognized. The left auricle and ventricle are huge.

The patient was explored for consideration of mitral commissurotomy, but marked regurgitation was found. Death occurred on the third postoperative day.

A frontal film of the chest (Fig. 9) showed conges-

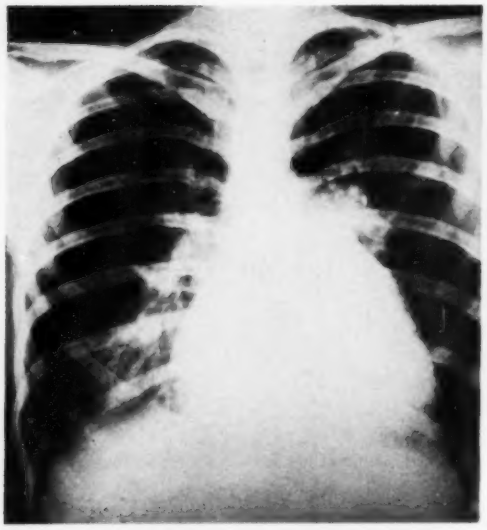


Fig. 9. Case IX. Frontal film showing congestion of the lungs and enlargement of the lung roots. The appearance suggests rheumatic heart disease with mitral valve involvement.

tion of the lungs. The lung roots were enlarged, as were all the pulmonary vessels. The heart, also, was generally enlarged. The appearance suggested rheumatic heart disease with mitral valve involvement.

Autopsy Findings: The heart weighed 450 gm. (normal, 235 gm.). It was diffusely enlarged. The right ventricular wall measured 4 to 6 mm. in thickness; the left measured 15 mm. The mitral valve was slightly enlarged and was markedly insufficient due to fibrous adhesions of the posterior leaflet to the endocardium. The left ventricle showed a diffuse, opaque, white, fibrous endocardial thickening, which measured up to 3 mm. and almost obliterated muscular trabeculae. The atria were not involved. The coronary vessels were normal.

The lungs were congested and edematous. The pulmonary arteries showed focal intimal atheromata. In the right lower lobe were 5-cm. wedge-shaped infarcts. Small infarcts were also found in both kidneys.

Microscopic sections of the left ventricle showed a marked thickening of the endocardium by fibroelastic tissue.

Final Diagnosis: Endocardial fibroelastosis, left ventricle, with involvement of the mitral valve.

DIFFERENTIAL DIAGNOSIS

To be differentiated from endocardial fibroelastosis are the other members of the group of "primary myocardial disease," namely, anomalous origin of the left coronary artery from the pulmonary artery (Fig. 10), glycogen storage disease of the heart (Fig. 11), tumors of the heart (Fig. 12), medial necrosis of the coronary arteries, and idiopathic myocarditis. Some cases of hypertrophy remain "idiopathic" even after complete autopsy study (Fig. 13). The roentgen appearance of this group is in all respects compatible with endocardial fibroelastosis. There are no clinical, electrocardiographic, or physiologic findings available at this time which make a differential diagnosis between these various entities possible. Some may take exception to this last statement so far as electrocardiographic findings are concerned, but in the material presented a distinction could not be made.

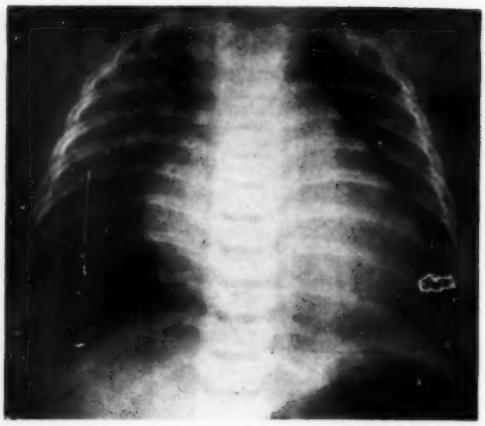


Fig. 10. Anomalous origin of the left coronary artery from the pulmonary artery (age five months).

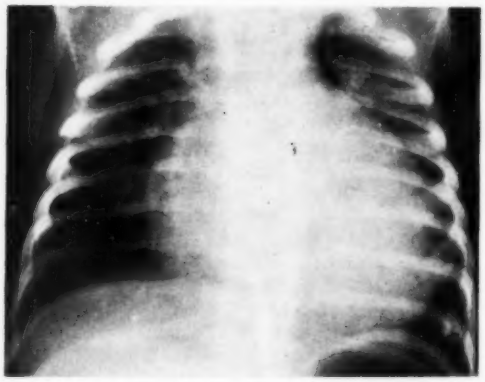


Fig. 11. Glycogen storage disease of the left ventricle (age one month).

SUMMARY

1. Endocardial fibroelastosis may occur as an isolated cardiac abnormality, apparently due to a developmental defect, at least in infants and children. Eight cases are presented which fall in this group. The age range was from birth to twenty-nine years.

2. The disease may be associated with other anomalies of the heart or great vessels, such as aortic stenosis. In one of the cases reported here there was an associated aortic-pulmonary window.

3. Fibroelastosis commonly occurs with coronary artery arteriosclerosis and with anomalous origin of the left coronary from the pulmonary artery. The endocardial

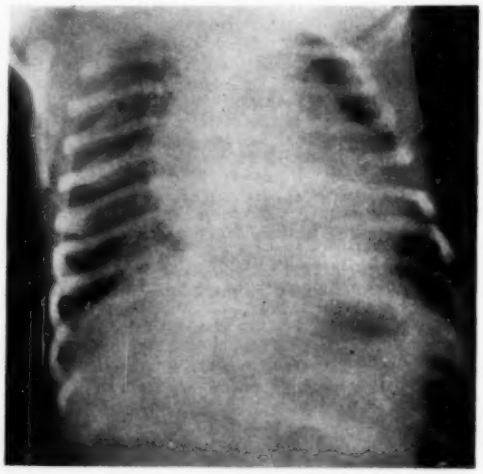


Fig. 12. Fibroma of left ventricle (age two days).

change may be secondary to the other abnormalities.

4. Complete clinical, electrocardiographic, and physiological studies (catheterization), as well a roentgen examination, are required to rule out septal defects and great vessel anomalies. The group of conditions with cardiac enlargement remaining includes the "primary myocardial diseases," namely endocardial fibroelastosis, glycogen storage disease, idiopathic myocarditis, medial necrosis of coronary arteries, tumors of the heart, and origin of the left coronary from the pulmonary

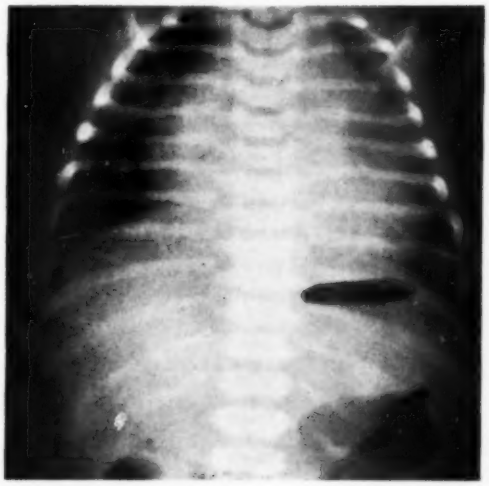


Fig. 13. Hypertrophy of the heart, believed to be "idiopathic" after complete autopsy study (age one week).

artery. A few remain unclassified even after autopsy study. Differential diagnosis of fibroelastosis from the other primary myocardial diseases usually cannot be made by roentgen or other studies.

5. Roentgen examination in infants having endocardial fibroelastosis usually reveals a globular heart and prominence of vessels during failure. In older patients the heart is not globular in contour, but does show specific chamber enlargement.

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REFERENCES

1. BAHN, R. C., EDWARDS, J. E., AND DUSHANE, J. W.: Coarctation of the Aorta as a Cause of Death in Early Infancy. Pediatrics **8**: 192–202, August 1951.

2. BLUMBERG, R. W., AND LYON, R. A.: Endocardial Sclerosis. Am. J. Dis. Child. **84**: 291–308, September 1952.

3. Case Records of the Massachusetts General Hospital. New England J. Med. **249**: 734–738, Oct. 29, 1953.

4. Case Records of the Massachusetts General Hospital. New England J. Med. **250**: 252–256, Feb. 11, 1954.

5. COLLIER, F. C., AND ROSAHN, P. D.: Endocardial Fibroelastosis. Report of Two Cases. Pediatrics **7**: 175–181, February 1951.

6. CRAIG, J. M.: Congenital Endocardial Sclerosis. Bull. Internat. A. M. M. **30**: 15–67, November 1949.

7. CROME, L.: The Structural Features of Epiloia with Special Reference to Endocardial Fibroelastosis. J. Clin. Path. **7**: 137–140, May 1954.

8. DENNIS, J. L., HANSEN, A. E., AND CORPENING, T. H.: Endocardial Fibroelastosis. Pediatrics **12**: 130–140, August 1953.

9. DUSHANE, J. W., AND EDWARDS, J. E.: Cardiac Clinics. CXLII. Congenital Aortic Stenosis in Association with Endocardial Sclerosis of the Left Ventricle. Proc. Staff Meet., Mayo Clinic **29**: 102–108, Feb. 24, 1954.

10. Endomyocardial Fibroelastosis. Editorial. J.A.M.A. **155**: 1583, Aug. 28, 1954.

11. EDMONDS, H. W., AND SEELYE, W. B.: Endocardial Sclerosis. Review of Changing Concepts with Report of 6 Cases. Pediatrics **7**: 651–659, May 1951.

12. FREER, J. L., AND MATHESON, W. J.: Left Auricular Enlargement in Endocardial Fibroelastosis. Arch. Dis. Childhood **28**: 284–287, August 1953.

13. GASUL, B. M , AND LOEFFLER, E.: Anomalous Origin of the Left Coronary Artery from the Pulmonary Artery (Bland-White-Garland Syndrome). Pediatrics **4**: 498–507, October 1949.

14. GOWING, N.: Congenital Fibroelastosis of the Endocardium. J. Path. & Bacteriol. **65**: 13–28, 1953.

15. GREAVES, J. L., WILKINS, P. S. W., AND PEARSON, S.: Endocardial Fibroelastosis in Identical Twins. Arch. Dis. Childhood **29**: 447–450, October 1954.

16. GROSS, P.: Concept of Fetal Endocarditis. General Review with Report of Illustrative Case. Arch. Path. **31**: 163–177, February 1941.

17. HALLIDAY, W. R.: Endomyocardial Fibroelastosis. A Study of 30 Cases. Dis. of Chest **26**: 27–40, July 1954.

18. HILL, W. T., AND REILLY, W. A.: Endocardial Fibroelastosis. Am. J. Dis. Child. **82**: 579–586, November 1951.

19. JOHNSON, F. R.: Anoxia as the Cause of Endocardial Fibroelastosis in Infancy. Arch. Path. **54**: 237–247, September 1952.

20. JOHNSON, F. R.: "Cardiac Hypertrophy in Infancy." Ped. Clin. North America **1**: 235–250, 1954.

21. KATZ, B. E., AND ADAMS, F. H.: Endocardial Fibroelastosis. Report of Unusual Case with Impaired Ability to Fabricate Serum Proteins. Am. J. Dis. Child. **86**: 186–197, August 1953.

22. KEPLER, M. O.: A Case of Endocardial Fibroelastosis with Patent Ductus Arteriosus from Above the Arctic Circle. Northwest Med. **51**: 775–777, September 1952.

23. KUGEL, M. A., AND STOLOFF, E. G.: Dilatation and Hypertrophy of the Heart in Infants and in Young Children, with Myocardial Degeneration and Fibrosis (So-Called Congenital Idiopathic Hypertrophy). Am. J. Dis. Child. **45**: 828–864, April 1933.

24. MACGREGOR, R. R., AND MCKENDRY, R.: Fetal Endocarditis. Report of a Case. Canad. M. A. J. **50**: 433–435, May 1944.

25. MAHON, G. S.: Idiopathic Hypertrophy of the Heart with Endocardial Fibrosis. Report of 2 Cases. Am. Heart J. **12**: 608–617, November 1936.

26. MCKINLEY, H. I., ANDREWS, J., AND NEILL, C. A.: Left Coronary Artery from the Pulmonary Artery. Three Cases, One with Cardiac Tamponade. Pediatrics **8**: 828–840, December 1951.

27. OPPENHEIMER, E. H.: The Association of "Adult Type" Coarctation of the Aorta with Endocardial Fibroelastosis in Infancy. Bull. Johns Hopkins Hosp. **93**: 309–319, 1953.

28. POTOTSCHNIG, G.: Über die kongenitale diffuse Endokardhyperplasie des linkens Ventrikels. Ztschr. f. ang. Anat. **4**: 234–253, 1919.

29. PRIOR, J. T., AND WYATT, T. C.: Endocardial Fibro-Elastosis: A Study of Eight Cases. Am. J. Path. **26**: 969–987, November 1950.

30. ROSENBAUM, H. D., NADAS, A. S., AND NEUHAUSER, E. B. D.: Primary Myocardial Disease in Infancy and Childhood. Am. J. Dis. Child. **86**: 28–44, July 1953.

31. SANO, M. E., AND ANDERSON, N. A.: Elastic Tissue Hyperplasia of the Endocardium. Arch. Path. **33**: 533–536, April 1942.

32. STADLER, H. E., REID, C. A., AND FRIEDMAN, H. P.: Prenatal Fibroelastosis ("Fetal Endocarditis") Manifested Clinically by Total Heart Block. J. Pediat. **36**: 370–375, March 1950.

33. STOHR, G.: Malformations of the Heart of the Newborn. Congenital Lesions Suggestive of Inflammatory Origin. Arch. Path. **17**: 311–323, March 1934.

34. THOMAS, W. A., RANDALL, R. V., BLAND, E. F., AND CASTLEMAN, B.: Endocardial Fibroelastosis: A Factor in Heart Disease of Obscure Etiology. A Study of 20 Autopsied Cases in Children and Adults. New England J. Med. **251**: 327–338, Aug. 26, 1954.

35. WEISMAN, S. J.: Congenital Idiopathic Cardiac Hypertrophy. Arch. Path. **33**: 365–371, March 1942.

36. WEINBERG, T., AND HIMELFARB, A. J.: Endocardial Fibroelastosis (So-Called Fetal Endocarditis). Report of 2 Cases Occurring in Siblings. Bull. Johns Hopkins Hosp. **72**: 299–306, May 1943.

SUMARIO

Fibroelastosis Endocardíaca. Aspecto Roentgenológico

La fibroelastosis endocardíaca puede presentarse ya como anomalía cardíaca aislada, debida aparentemente a un vicio del desarrollo, o ir unida a otras anomalías del corazón y los vasos mayores, p. ej., estenosis aórtica. Ocurre comúnmente con arteriosclerosis de las coronarias y con un origen anómalo de la coronaria izquierda partiendo de la arteria pulmonar.

La alteración del endocardio varía en su intensidad, pero suele ser reconocible a la inspección macroscópica de las caras endocardíacas, que muestran un espesamiento brillante de color gris-blanco, debido a una gruesa capa de fibras elásticas y de colágeno, que puede extenderse hasta las válvulas, invadiendo éstas. El lado izquierdo del corazón es el afectado más a menudo. Las características clínicas comprenden dificultades respiratorias y varias manifestaciones de insuficiencia cardíaca. Sólo cuando ésta existe se nota cianosis.

El examen roentgenológico revela una circulación pulmonar normal si hay compensación cardíaca; en la insuficiencia del corazón izquierdo, se destacan más los vasos. El corazón parece a menudo globular, sobre todo en los lactantes; en los enfermos de más edad, se observan hipertrofias específicas de las cavidades.

Para excluir los defectos de los tabiques y las anomalías de los grandes vasos, se necesitan completos estudios clínicos, electrocardiográficos y fisiológicos (cateterismo), así como el examen roentgenológico. El grupo de dolencias en que resta hipertrofia cardíaca comprende las "afecciones cardíacas primarias," a saber, fibroelastosis endocardíaca, enfermedad de la fijación del glucógeno, miocarditis idiopática, necrosis medial de las arterias coronarias, tumores del corazón y origen de la coronaria izquierda en la arteria pulmonar. Algunas permanecen sin clasificar aun después del estudio autópsico. Por lo general, no cabe hacer con estudios roentgenológicos o de otro género el diagnóstico diferencial de la fibroelastosis de las demás afecciones miocardíacas primarias.

Preséntanse 9 casos: 8 en niños de tres meses a cinco años y medio de edad y uno en una mujer de veintinueve años que tenía además comunicación aórtico-pulmonar. La trascendencia de la fibroelastosis endocardíaca, a falta de toda terapéutica específica (aparte del tratamiento encaminado a la insuficiencia cardíaca en general) estriba en lo importante que es distinguirla de las enfermedades que ceden a la cirugía.

Evaluation of Intrapulmonic Adenopathy in Sarcoidosis[1]

RUSSELL WIGH, M.D., and ELEANOR D. MONTAGUE, M.D.

THE DISEASES usually considered by the radiologist in cases of intrathoracic lymph node enlargement in adults are sarcoidosis and the malignant lymphomas, including Hodgkin's disease. The material presented here represents an effort to establish roentgen criteria for the separation of Boeck's sarcoidosis from the other, more serious causes of intrathoracic adenopathy.

This investigation was prompted by the observation, in routine work, of the frequency with which the descending branches of the pulmonary arteries, usually the right, *appeared* enlarged and changed in contour due to contiguous lymphadenopathy. This led to a statistical study of the occurrence of this pattern in patients with Boeck's sarcoidosis. Groups of cases of the lymphomatoid neoplasms were also analyzed to determine the frequency of the finding in these conditions.

Sarcoidosis has been studied and reported by members of almost every specialty since the first description of its skin manifestations by Besnier (1) in 1889. The earliest note about the disease in the American literature appeared in 1898, when Osler (6) presented a case with chronic symmetrical enlargement of the salivary and lacrimal glands.

The pathologic process is fairly well recognized, but the etiology remains obscure. The fundamental lesion is a granulomatous, non-caseating tubercle consisting of large pale epithelioid cells collected in nests or well defined nodules, with little or no surrounding zone of lymphocytes (3). Occasional multinucleated giant cells with or without the doubly refracti' bo' s of Schaumann (8) are seen. Neith a osis nor caseation is observed, and only occasionally are small areas of calcification noted. Sarcoid lesions are widely disseminated and have been described in almost every organ.

CLINICAL MATERIAL

The selection of clinical material for statistical evaluation of any disease with unknown etiology can be difficult. For this study, all the records over an eleven-year period in which the final diagnosis was sarcoidosis, as well as the records in which sarcoidosis appeared among the differential diagnoses, were reviewed. These totaled 103 and may be classified as follows:

	Cases
Roentgenograms not available	25
Inadequate clinical study	6
Diagnosis controversial	4
Cases accepted as established	68
Negative chest roentgenogram	15
Parenchymal disease, no lymphadenopathy	3
Sarcoidosis with intrathoracic lymphadenopathy	50

Since the purpose of this study was the evaluation of intrathoracic lymph node groupings, 3 cases with parenchymal disease only were excluded. There remained 50 cases of sarcoidosis with intrathoracic adenopathy with or without parenchymal change. The basic reasons for the acceptance of these 50 cases as established examples of sarcoidosis were:

	Cases
Positive biopsy	37
Positive Kveim test and negative Mantoux test	8
Positive Kveim test with positive or equivocal Mantoux test	2
Negative Mantoux test, Kveim not done (included because these patients had good clinical corroboration)	3

Table I analyzes the clinical data for the series.

Kviem testing, tuberculin reactions, and some of the skin findings are worthy of comment.

[1] From the Department of Radiology of the College of Physicians and Surgeons, Columbia University, and the Radiological Service of the Presbyterian Hospital, New York, N. Y. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

TABLE I: CLINICAL DATA FROM 50 CASES OF SARCOIDOSIS

(Age range: 20–63 years. Median: 32)

		Number	Per Cent
Sex			
Female		39	78
Male		11	22
Race			
White		13	26
Colored		37	74
Peripheral nodes		32	64
Respiratory symptoms		26	54
Skin lesions			
Sarcoid		19	38
Erythema nodosum		3	6
Iridocyclitis, uveitis		16	32
Hepatomegaly		16	32
Splenomegaly		13	26
Gland enlargement		8	16
Parotid	6		
Submaxillary	1		
Lacrimal	1		
Bone: roentgenologic changes		6	12
Bone pain		5	10
Kveim tests performed		38	
Positive	30		79
Negative	8		21
Negative Mantoux test		37	74
Globulin determination		46	
Elevated	22		48
Normal	24		52
Eosinophilia		5	10

Danbolt's (2) studies of the reactions of both normal controls and patients with sarcoidosis to the intracutaneous Kveim test established certain facts. In no instance did the skin reaction in the controls last over a month, while 90 per cent of the sarcoid patients had positive reactions (lasting over one month). On the basis of these observations, we have included 10 positive reactors as suitable cases for this study, even though biopsies were not done. In all instances, there was substantial clinical support for the diagnosis.

All patients had one or more Mantoux tests. Thirty-seven were negative; 11 of the 13 remaining patients reacted positively but had biopsies consistent with sarcoidosis. The remaining 2 patients with positive or equivocal Mantoux tests had positive Kveim reactions and their sputum was negative both by culture and guinea-pig inoculation.

Skin findings characteristic of erythema nodosum occurred in 3 of the 50 cases of sarcoidosis. In these 3 patients not only were lymph node and skin biopsies positive for sarcoidosis, but positive skin biopsies for erythema nodosum were also obtained. These cases are considered as instances of intrathoracic lymphadenopathy due to sarcoidosis with concomitant erythema nodosum. There is no reason to believe that the intrathoracic lymphadenopathy was a result of the latter disease. Studies (5) concerning the relationship of the two conditions indicate that as high as 25 per cent of sarcoid patients have skin lesions of erythema nodosum at some time during their course.

ANATOMY

Inasmuch as some of the nodes attracting specific attention in sarcoidosis are distinct from the usually designated "hilar nodes," it seems desirable to include a short review of the lymphatic node distribution in the thorax. In fact, the nodes under consideration appear to be intrapulmonary rather than confined to the lung roots. Rouvière's (7) classification is helpful. Briefly it is as follows:

I. Anterior mediastinal or prevascular nodes
II. Posterior mediastinal nodes
III. Peritracheobronchial nodes
  (*a*) Peritracheal nodes
  (*b*) Nodes of the bifurcation or intertracheobronchial nodes
  (*c*) Nodes of the pulmonary roots
    1. Anterior
    2. Posterior
    3. Superior
    4. Inferior
IV. Intrapulmonary nodes
  (*a*) Superficial or subpleural nodes
  (*b*) Intrapulmonary nodes proper (synonyms include pulmonary nodes, bronchopulmonary nodes, bronchial nodes, interbronchial nodes)

Rouvière states that the intrapulmonary nodes are generally near the angles of division of the bronchi, arteries, or veins. Originally these lymphoid elements were extrapulmonary, occurring at the root of each lobe. During development, however, they became situated in lobar or interlobar areas. An increase in size of the intrapulmonary nodes situated in close relationship to the descending branches of the pulmonary arteries apparently accounts for the pattern change in sarcoidosis.

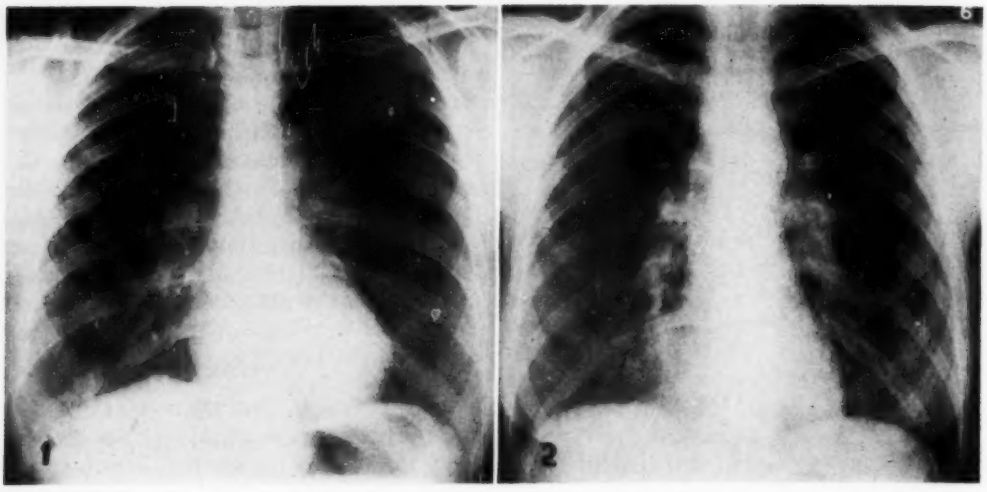

Fig. 1. Sarcoidosis with bilateral hilar and right intrapulmonic lymphadenopathy. Large nodes obscure the right descending pulmonary artery and replace its shadow with a lobular one following the course of the artery.
Fig. 2. Irregular and somewhat lobular shadows in the descending pulmonary artery areas.

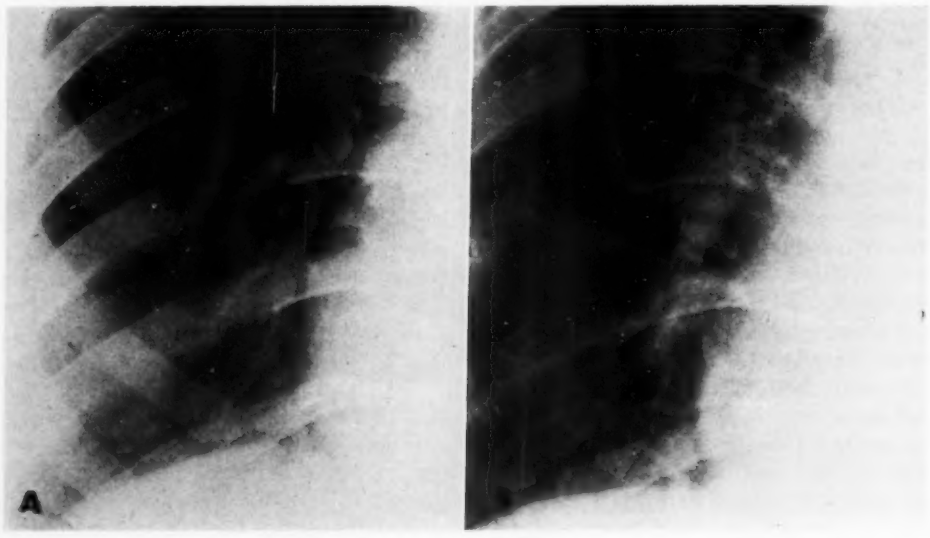

Fig. 3. A. Chest roentgenogram obtained prior to identifiable thoracic disease. The right pulmonary artery is normal in appearance. B. Twenty-eight months later, the contours of the pulmonary artery area are noticeably changed. Although the width of the "artery" is not beyond an anticipated normal size, its shadow is larger than in A, and there is irregularity of its contours.

ROENTGENOLOGIC FINDINGS

With the involvement and subsequent enlargement of the intrapulmonic nodes, rather definite changes occur along the course of the descending pulmonary arteries. These changes are more evident on the right than on the left side, since the heart shadow obscures the greater portion of the pulmonary artery on the left. The predominant feature is a distinct increase in the width of the *apparent* pulmonary artery shadow. At times this is quite marked, in which event the actual vessel may not be identifiable; its shadow is

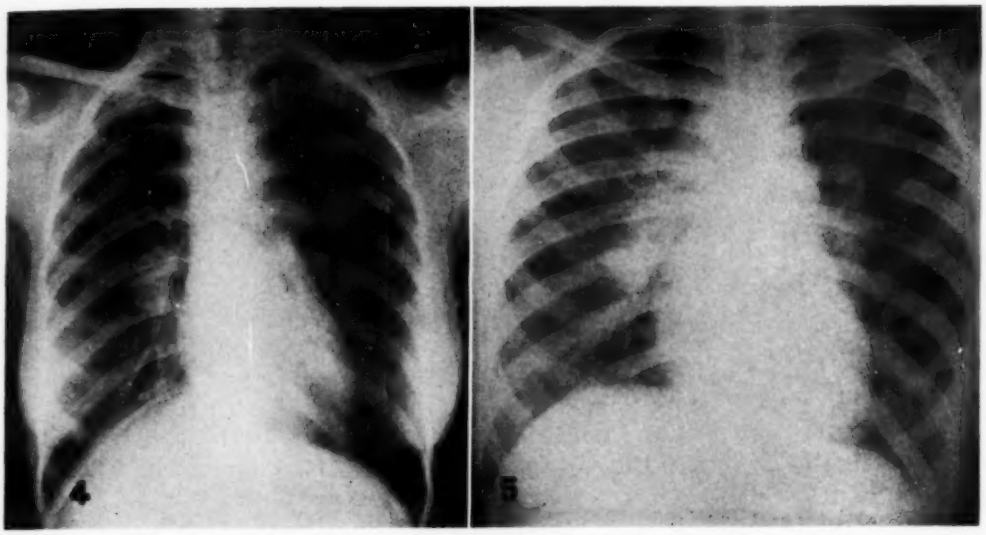

Fig. 4. Intrapulmonic lymph nodes conceal the main portion of the right descending pulmonary artery. At the site of the emergent pulmonary artery branches, the transition in contour produces a "squaring" effect as contrasted with the normal tapering of a pulmonary artery.

Fig. 5. The squaring or transitional effect between intrapulmonic nodes and pulmonary artery radicals inferiorly is demonstrated in the right hemithorax.

replaced by a thick lobulated one (Fig. 1) which takes a course following that of the artery and usually remains separated from the heart. When the increase in size is less pronounced, the contours are still relatively lobular or irregular, due to the para-arterial lymphadenopathy (Fig. 2). Occasionally no discrete nodes are seen but still the artery appears widened and its margins irregular. Some changes of this type are so slight that for illustrative purposes they are best compared with the appearance of the pulmonary artery contour prior to the onset of disease or during a remission (Fig. 3).

At the distal extremity of the adenopathy along the right descending pulmonary artery, an abrupt transition is frequently seen between the enlargement caused by the masses and the shadows of the emerging smaller branches of the pulmonary artery. This is in contrast to the gradual tapering of a normal pulmonary artery (Fig. 3A), where the size of the dividing branches is relatively equivalent to that of the main descending pulmonary artery. The abnormality produces the "squaring" effect illustrated in Figures 4 and 5.

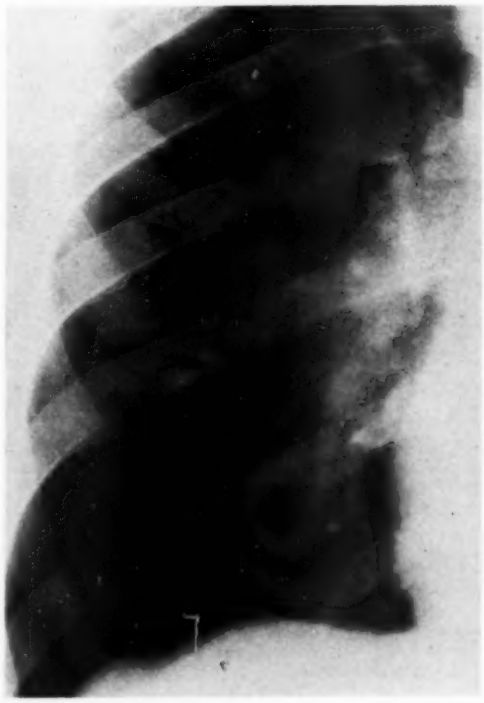

Fig. 6. Roentgenogram showing the right descending pulmonary artery, identifiable through the lymphadenopathy.

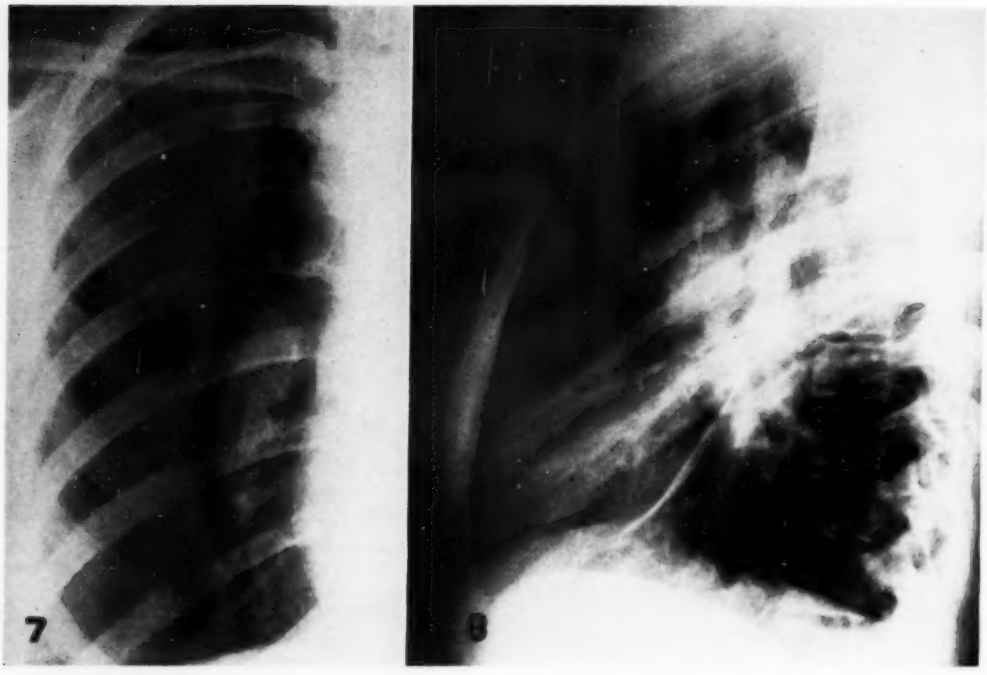

Fig. 7. The intrapulmonic lymph nodes are seen to occur predominantly along the lateral aspect of the artery. A clear zone tends to be preserved between the artery-node area and the heart.
Fig. 8. The lateral roentgenogram indicates the extent to which these enlarged intrapulmonic nodes may reach beyond the hilus.

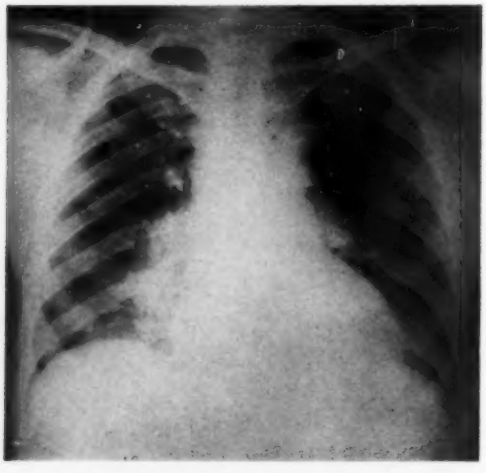

Fig. 9. The right parapulmonic nodes reach almost to the diaphragmatic level.

Efforts at dissociation of the shadows will frequently indicate that in roentgenograms of optimum contrast the right pulmonary artery can actually be traced through the nodes (Fig. 6).

It is of interest that medially one may see a relatively straight normal contour, the increase in width due to the adenopathy being predominantly on the lateral aspect of the artery. These changes, coupled with the fact that deep in the lung the nodes do not become extraordinarily huge, tend to preserve a clear zone between the artery and heart shadow (Fig. 7). This combination produces a relatively striking sign of intrapulmonic node enlargement.

Lateral roentgenograms may reveal quite clearly the extent of intrapulmonic adenopathy (Fig. 8) and lend emphasis to the fact that these nodes are too far distal to be considered hilar in any sense of the word. On this point there need be no controversy, since even on postero-anterior projection it is evident that they are situated beyond the confines of an area generally considered as hilar. At times they may reach almost

TABLE II: INTRATHORACIC ADENOPATHY IN 50 CASES OF SARCOIDOSIS

Intrapulmonic (Right Para-arterial) Nodes Present		Intrapulmonic (Right Para-arterial) Nodes Absent	
Number of Cases	40	Number of Cases	10*
Appearance on first roentgenogram	36		
Appearance on subsequent roentgenogram	4		
Other Nodes Apparent		Other Nodes Apparent	
Anterior mediastinal	4	Anterior mediastinal	0
Hilar	38	Hilar	10
Paratracheal, right	17	Paratracheal, right	2
Node of the obliterated ductus arteriosus (Botallo)	12	Node of the obliterated ductus arteriosus (Botallo)	3

* In 2 cases, presence or absence was considered indeterminate because the descending pulmonary artery areas were concealed by parenchymal disease. For statistical purposes the nodes were considered as absent.

TABLE III: INTRATHORACIC ADENOPATHY IN 42 CASES OF LYMPHOSARCOMA AND HODGKIN'S DISEASE

Intrapulmonic (Right Para-arterial) Nodes Present		Intrapulmonic (Right Para-arterial) Nodes Absent	
Number of Cases	11	Number of Cases	31*
Appearance on first roentgenogram	9		
Appearance on subsequent roentgenogram	2		
Other Nodes Apparent		Other Nodes Apparent	
Anterior mediastinal	5	Anterior mediastinal	23
Hilar	9	Hilar	13
Paratracheal, right	3	Paratracheal, right	3

* In 2 cases, presence or absence was considered indeterminate. However, the pulmonary artery areas were concealed by such huge bulky masses, that they would undoubtedly be considered as neoplasms.

to the level of the diaphragmatic dome (Fig. 9).

In Table II, the 50 cases of sarcoidosis are grouped according to the presence or absence of intrapulmonic nodes following the course of the right pulmonary artery (para-arterial). The table also summarizes the frequency of other intrathoracic nodes for each of these two groups.

For comparative purposes, 128 consecutive charts of lymphosarcoma patients (reticulum-cell and small-cell types) and 55 cases of Hodgkin's disease were analyzed. Among these were 23 proved cases of Hodgkin's disease and 19 of lymphosarcoma with intrathoracic nodes. As far as intrathoracic lymphadenopathy was concerned, there seemed to be no critical difference between the two conditions. Therefore, the findings are grouped together in Table III.

DISCUSSION

The characteristics of parenchymal disease were not analyzed in any detail. The usual types of pulmonary change were found in 72 per cent of the sarcoid cases. All but 6 patients with parenchymal disease had widening of the pulmonary artery shadow.

Table II shows the frequency with which sarcoidosis affects intrapulmonic nodes. In 36 of the 50 cases involvement of these nodes was demonstrated on the first roentgenogram indicating the presence of any intrathoracic lymphadenopathy, and in 4 additional cases on a subsequent film. In contrast, the intrapulmonic nodes were discernible in only 11 of 42 cases of lymphosarcoma and Hodgkin's disease (Table III).

In 1947, Garland (4) analyzed a group of sarcoid cases and found that in approximately one-half (13 of 24) the right paratracheal nodes were involved. These nodes were affected in 19 of our 50 cases, a relatively close agreement with Garland's findings. It is evident, however, that intrapulmonary adenopathy occurs with greater frequency than the paratracheal.

It is important to recognize how infrequently the anterior mediastinal nodes are affected in sarcoidosis (4 out of 50 cases) and how often they are enlarged in the neoplastic group (28 out of 42 cases).

Admittedly there is no way to differ-

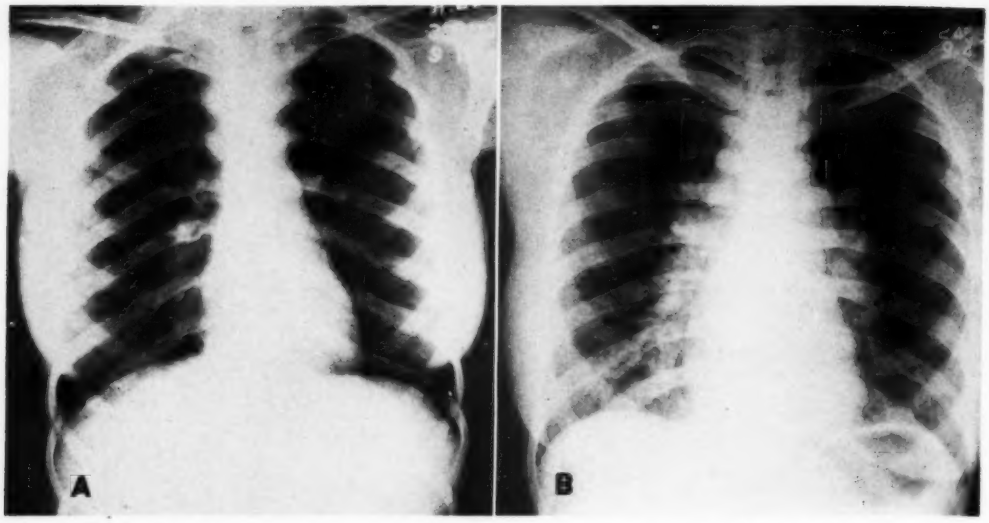

Fig. 10. A. Hodgkin's disease with bilateral mediastinal widening. B. Sarcoidosis with comparable mediastinal widening but with advanced intrapulmonic adenopathy.

entiate the intrapulmonic nodes of sarcoidosis from those due to malignant lymphomas (or other malignant disease). It is quite evident, however, that as an aid in the differential diagnosis their presence or absence is of distinct value.

No case of sarcoidosis was encountered in which bilateral mediastinal widening was present without intrapulmonic nodes, whereas such a situation is frequent in the lymphoblastomas (23 out of 31 cases). Figure 10 demonstrates this difference.

In an instance in which anterior mediastinal nodes are present but no intrapulmonic nodes are seen, one is obliged to make a diagnosis of cancer. When hilar nodes alone are present, one must consider cancer and sarcoidosis with equal weight. When parapulmonary artery nodes are present as well as anterior mediastinal nodes, cancer must be considered primarily since the latter finding is so infrequent in sarcoidosis. When nodes are seen along the right pulmonary artery and the anterior mediastinum is clear, the probability is far greater that the change is due to sarcoidosis than to lymphoblastoma.

CONCLUSIONS

1. Intrapulmonic adenopathy is present in 72 per cent of cases of sarcoidosis with intrathoracic lymph node enlargement as seen on the initial roentgenograms and in as high as 80 per cent of the cases when progress roentgenograms are considered. This adenopathy is most readily detected along the course of the right descending pulmonary artery. It produces an *apparent* increase in the width of the artery shadow as well as a lobulated or irregular contour along a part of the course of the vessel.

2. The intrapulmonic lymph nodes are enlarged in only 25 per cent of cases of lymphosarcoma and Hodgkin's disease with intrathoracic lymphadenopathy.

3. The absence of intrapulmonic lymph node enlargement plus the presence of enlarged anterior mediastinal nodes is decidedly against the diagnosis of sarcoidosis. In the series here reported there was no case of sarcoidosis with anterior mediastinal nodes without right parapulmonary artery node involvement.

4. The typical adenopathic pattern in sarcoidosis is represented by the combined presence of intrapulmonic and hilar nodes and the absence of anterior mediastinal nodes. This pattern is infrequent in the lymphomatoid neoplasms.

REFERENCES

1. BESNIER, E.: Lupus pernio de la face: synovites fongueuses (scrofulotuberculeuses) symétriques des extrémités supérieures. Ann de dermat. et syph. **10:** 333–336, 1889.
2. DANBOLT, N.: On the Skin Test with Sarcoid-Tissue-Suspension (Kveim's Reaction). Acta dermat.-venereol. **31:** 184–193, 1951.
3. FREIMAN, D. G.: Medical Progress; Sarcoidosis. New England J. Med. **239:** 664–671, Oct. 28, 1948.
4. GARLAND, L. H.: Pulmonary Sarcoidosis: The Early Roentgen Findings. Radiology **48:** 333–352, April 1947.
5. KERLEY, P.: Etiology of Erythema Nodosum. Brit. J. Radiol. **16:** 199–204, July 1943.
6. OSLER, W.: On Chronic Symmetrical Enlargement of the Salivary and Lachrymal Glands. Am. J. M. Sc. **115:** 27–30, 1898.
7. ROUVIÈRE, H.: Anatomy of the Human Lymphatic System. A Compendium Translated from the Original Anatomie des lymphatiques de l'homme, and Rearranged for the Use of Students and Practitioners, by M. J. Tobias. Ann Arbor, Mich., Edwards Bros., 1938.
8. SCHAUMANN, J.: On Nature of Certain Peculiar Corpuscles Present in Tissue of Lymphogranulomatosis Benigna. Acta. med. Scandinav. **106:** 239–253, 1941.

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SUMARIO

Justipreciación de la Adenopatía Intrapulmonar en la Sarcoidosis

Una serie de 50 casos de sarcoidosis fué estudiada para determinar la frecuencia de la invasión de los ganglios intrapulmonares, según la revelaba el aparente aumento del ancho de la sombra de las porciones descendentes de la arteria pulmonar derecha y un contorno lobulado o irregular en parte del trayecto del vaso. En relación con este hallazgo, también se observaron grupos de casos de linfosarcoma y de enfermedad de Hodgkin.

En 36 casos de sarcoidosis, se observó que los ganglios linfáticos intrapulmonares estaban engrosados en las primeras radiografías que revelaban alguna linfadenopatía. En 4 casos más, se les encontró engrosados en el subsiguiente examen roentgenológico. La incidencia total representó 80 por ciento, comparado con 25 por ciento en los casos de linfosarcoma y de enfermedad de Hodgkin con linfadenopatía intratorácica.

La falta de engrosamiento de los ganglios linfáticos intrapulmonares unida a la presencia de hipertrofia de los ganglios del mediastino anterior milita decididamente contra el diagnóstico de sarcoidosis. En la serie de casos aquí presentados, no hubo ningún caso de sarcoidosis con ganglios del mediastino anterior engrosados sin invasión de los ganglios linfáticos de la arteria parapulmonar derecha.

En la sarcoidosis, el típico patrón adenopático está representado por la combinación de la presencia de ganglios intrapulmonares e hiliares y la ausencia de ganglios del mediastino anterior. Este patrón es raro en las neoplasias linfomatoideas.

Congenital Abnormalities of the Feet[1]

LAWRENCE A. DAVIS, M.D., and WILLIAM S. HATT, M.D.

THE RADIOLOGICAL literature contains little or nothing concerning the x-ray analysis of congenital abnormalities of the feet. Even the larger multivolume texts (1, 2, 3) devote scant space to such a common defect as clubfoot. The trained orthopedic surgeon relies to a great extent on his physical examination of the infant's foot, and has acquired a personal group of radiological criteria which, in conjunction with his clinical knowledge, suffice. Therefore, little in the way of a formal x-ray analysis appears in the orthopedic literature (4, 5).

In an attempt to formulate the radiological aspects of the more common abnormalities of the feet and put us on "speaking terms" with our orthopedic associates, the present study was undertaken.

The congenital abnormalities of the feet to be presented are: clubfoot (*talipes equinovarus*), "rocker deformity" (overcorrected clubfoot), flatfoot, metatarsus varus, and pes cavus.

The technic for obtaining anteroposterior and lateral roentgenograms must be carefully standardized and followed. Slight variations in rotation in either projection can markedly alter the relationship of the bones as shown on the film. For the anteroposterior view the knees must be held together and fall in a plane which is perpendicular to the film (Fig. 1A). The tendency of the technician to "correct" the abnormality by placing the foot "normally" on the cassette must be discouraged. For the lateral projection (Fig. 1B) the technic for a lateral ankle view is the correct one. In this position, rotation of a small degree will result in a change in the apparent relationship of the talus and calcaneus.

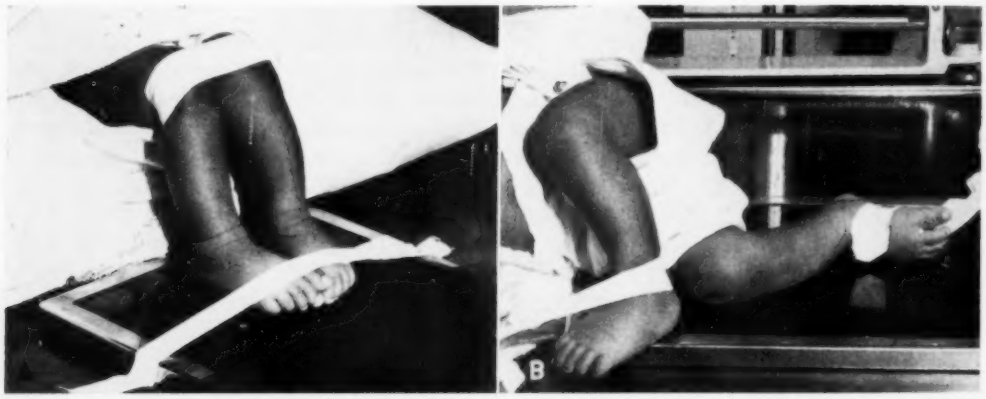

Fig. 1. A. Proper technic for taking anteroposterior film of the feet: knees together and legs straight. B. Proper technic for lateral view.

Since at birth the talus and calcaneus are the only tarsal bones which are ossified, the anatomical analysis consists essentially in a description of the relationship of these two bones to each other and to the metatarsals. In the accompanying illustrations these relationships are shown for the normal foot (Fig. 2) and the various abnormalities, as follows:

Clubfoot (Fig. 3): Clubfoot (*talipes equinovarus*) is said to occur once in 1,000

[1] From the Departments of Radiology and Surgery (Orthopedic Section), University of Louisville School of Medicine, and the Kosair Crippled Children Hospital, Louisville, Ky. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

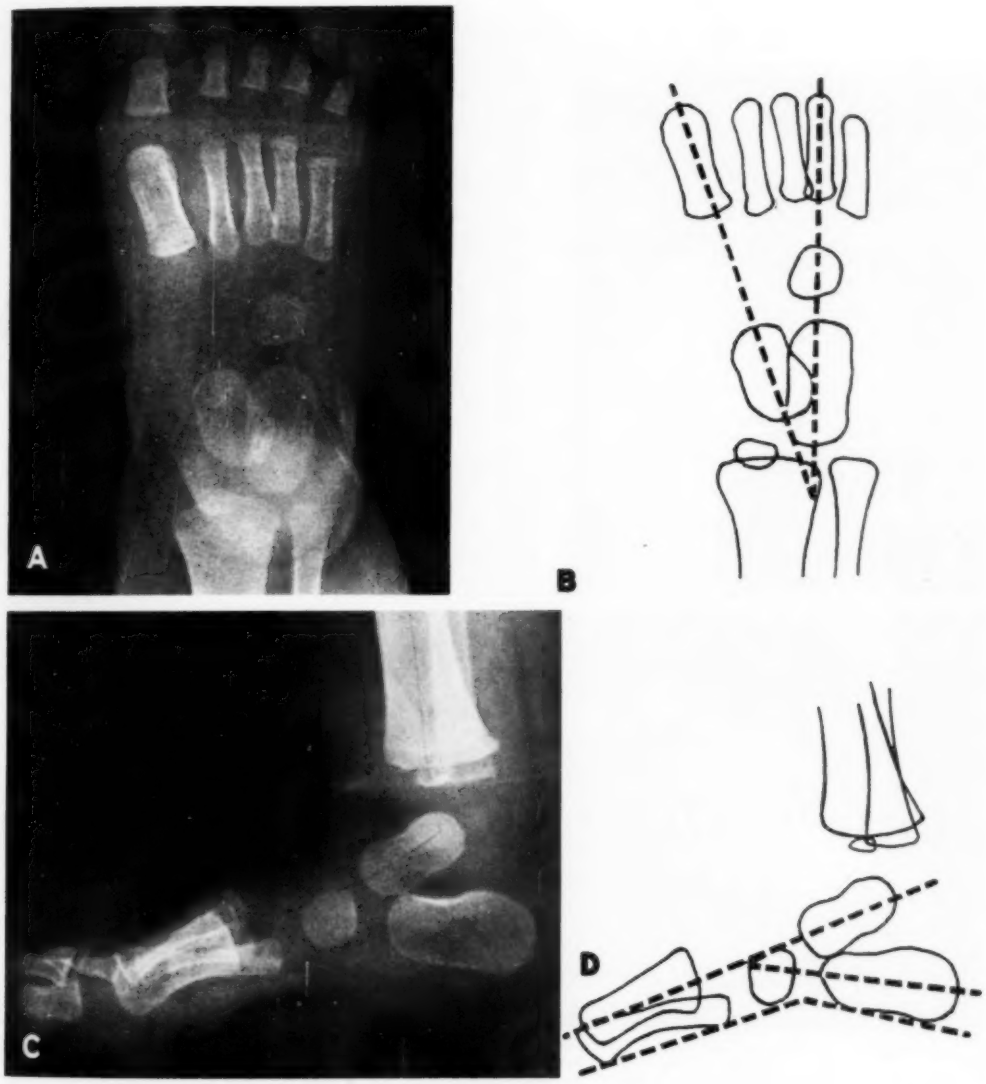

Fig. 2. Normal foot.

A and B. Anteroposterior projection. 1. The angle between the talus and calcaneus is 20 to 40°. 2. The line through the mid-talus points to the head of the 1st metatarsal. 3. The line through the mid-calcaneus points to the head of the 4th metatarsal. 4. The mid-talar and mid-calcaneal lines generally coincide with mid-shaft lines of the 1st and 4th metatarsals respectively. 5. Lines of metatarsal shafts are very nearly parallel.

C and D. Lateral projection. 1. The mid-talar line and the line through the shaft of the 1st metatarsal coincide. 2. An obtuse angle is formed by the line through the inferior cortex of the calcaneus and inferior cortex of the 5th metatarsal. 3. The mid-talar line and mid-calcaneal line tend to form an acute angle.

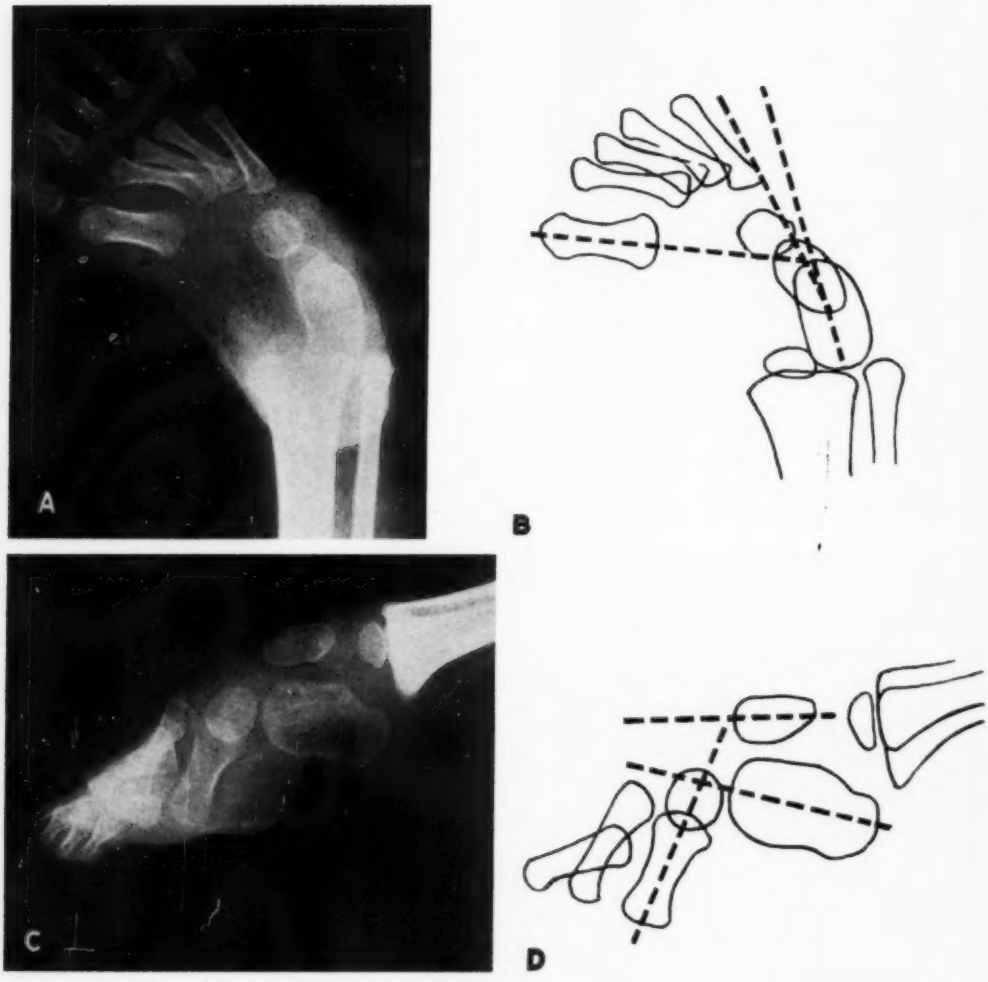

Fig. 3. Clubfoot.

A and B. Anteroposterior projection. 1. The talocalcaneal angle approaches 0 degrees or is even reversed. 2. Mid-talar line points lateral to normal position. 3. Mid-calcaneal line points lateral to normal position. 4. The mid-talar line and the line through the shaft of the 1st metatarsal now form an angle. 5. There is a loss of parallelism of metatarsals, with convergence posteriorly.

C and D. Lateral projection. 1. The mid-talar line and line through the shaft of the 1st metatarsal form an obtuse angle. 2. Mid-talar and mid-calcaneal lines approach parallelism.

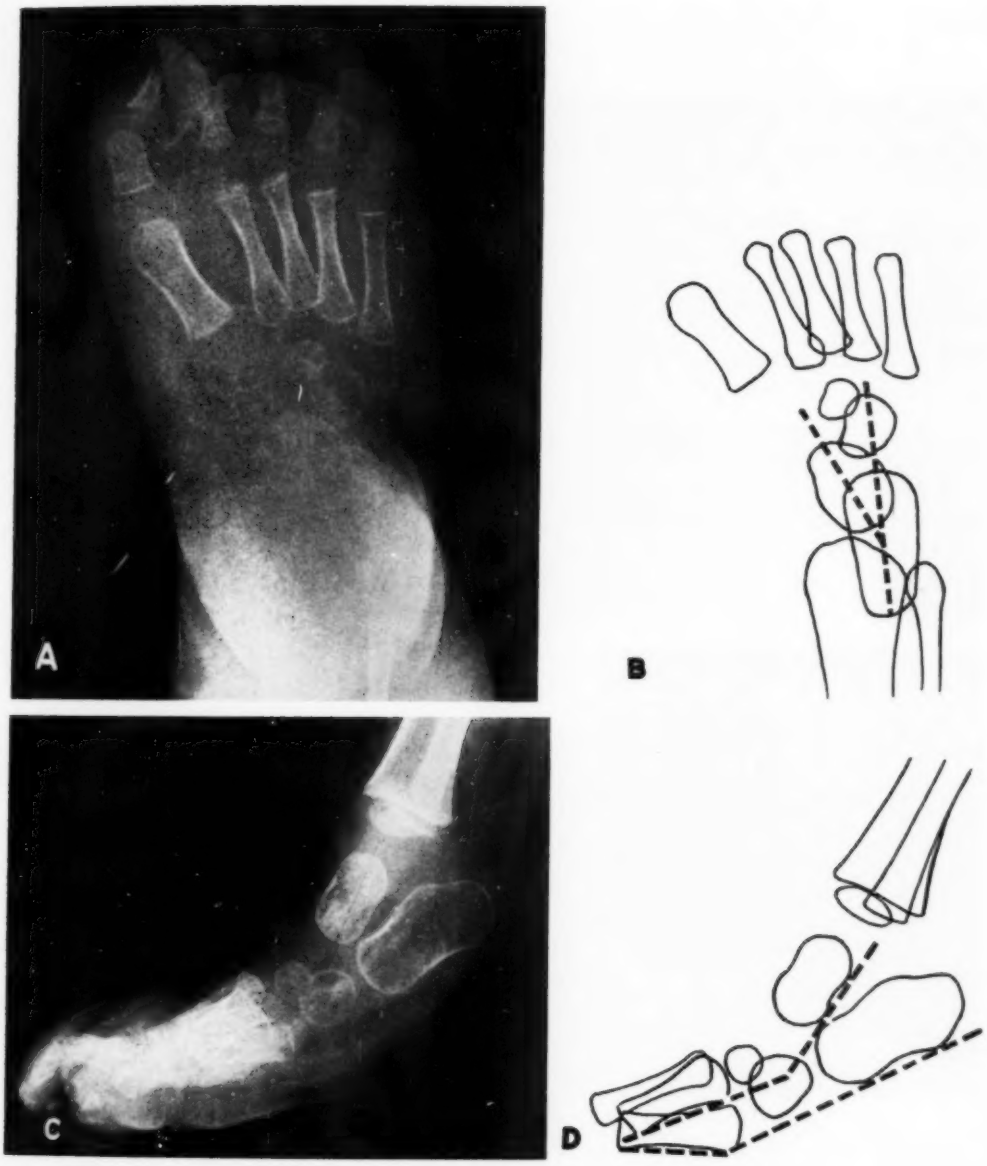

Fig. 4. "Rocker" deformity (overcorrected clubfoot).
A and B. Anteroposterior projection. 1. The angle between the calcaneus and talus is less than average. 2. The forefoot may or may not be normal.
C and D. Lateral projection. 1. Reverse angle between inferior cortex of calcaneus and 5th metatarsal. 2. Reverse angle between inferior cortex of talus and 1st metatarsal in severe cases.

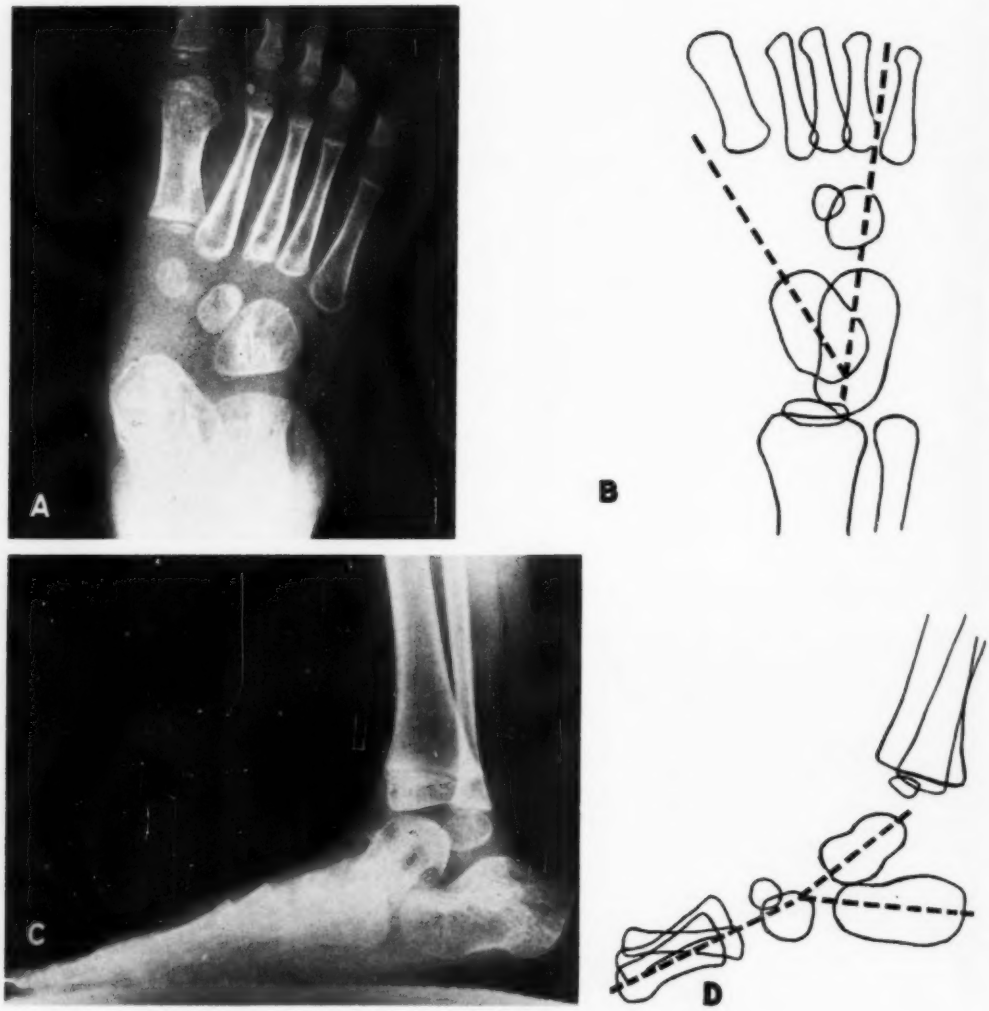

Fig. 5. Flatfoot.
A and B. Anteroposterior. 1. Increased talocalcaneal angle.
C and D. Lateral projection. 1. The line of the 1st metatarsal makes an angle instead of coinciding with the mid-talar line. 2. Frequently there is an increased talocalcaneal angle.

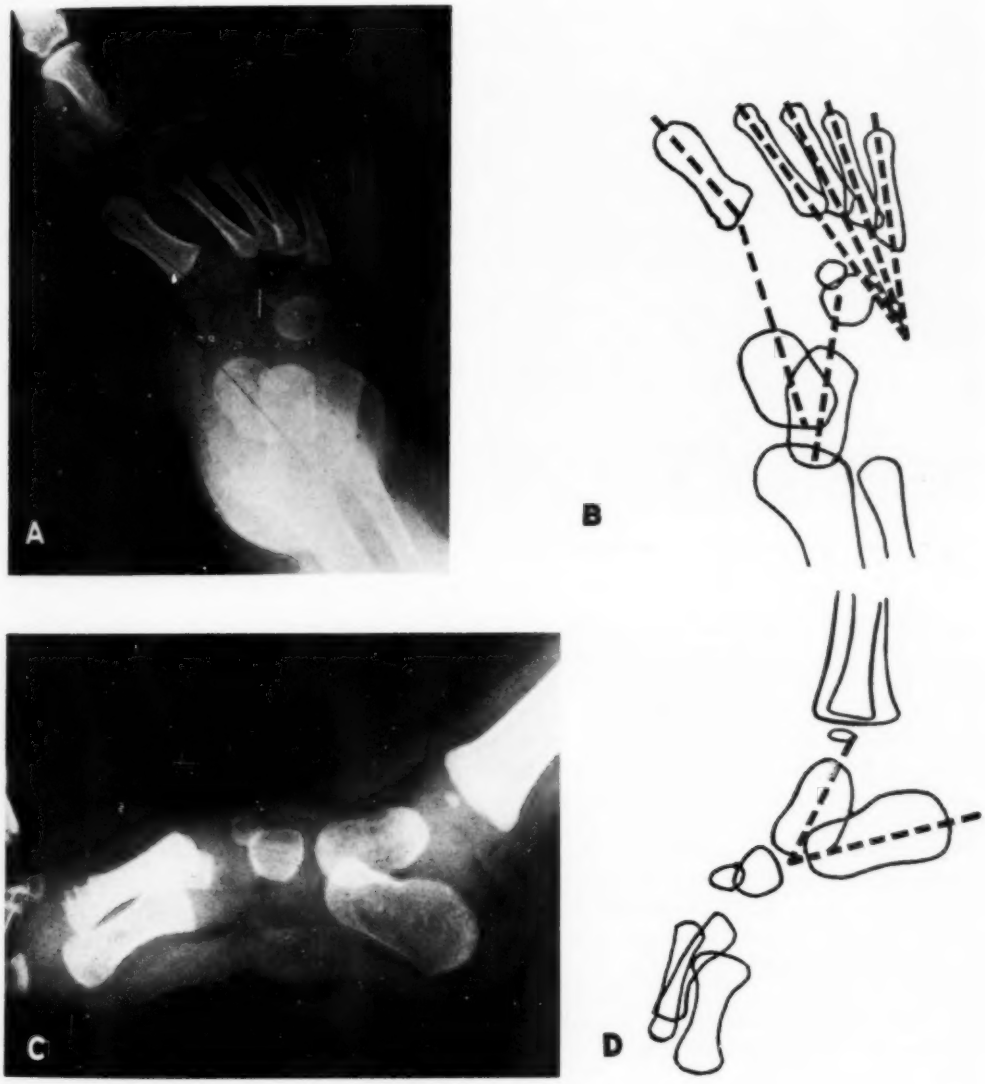

Fig. 6. Metatarsus varus.

A and B. Anteroposterior projection. 1. There is an increased angle between the mid-talar line and the line of the shaft of the 1st metatarsal. 2. The lines of the metatarsals converge posteriorly. 3. The mid-calcaneal line runs lateral to the normal position.

C and D. Lateral projection. 1. The angle between the mid-calcaneal and mid-talar line may increase.

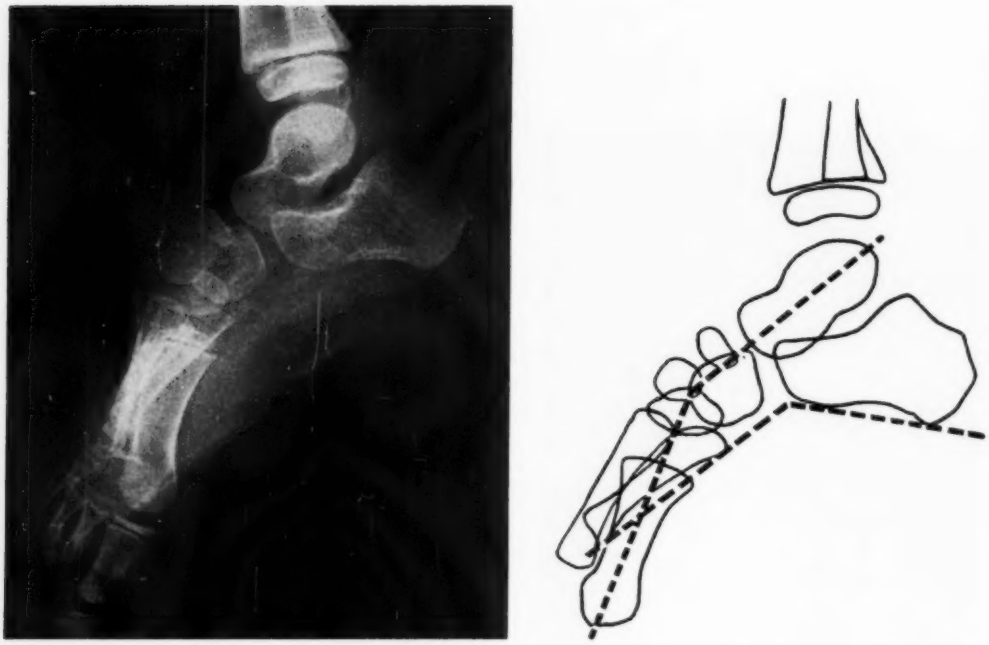

Fig. 7. Pes cavus.
The anteroposterior projection is unchanged from the normal. Lateral Projection. 1. Increased angle between the line through the inferior cortex of the calcaneus and inferior cortex of the 5th metatarsal. 2. There is now an angle between the mid-talar line and the line through the shaft of the 1st metatarsal.

births (4). In 57 per cent of the cases it is unilateral. The deformity consists of three component parts: (*a*) adduction deformity of the forefoot; (*b*) inversion deformity, occurring mainly in the subtalar joint; (*c*) equinus deformity. Both forefoot and ankle equinus contribute to this latter deformity.

"*Rocker Deformity*" (Fig. 4): In correction of the equinus of a clubfoot, the longitudinal arch in the mid-talar joint is apt to "break," causing the characteristic "rocker" deformity.

Flatfoot (Fig. 5): The foot is pronated and the radiographic characteristics are the reverse of many of those associated with clubfoot.

Metatarsus varus (Fig. 6): In this condition there is forefoot adduction, as in clubfoot, but the heel is in the valgus position. A milder form of this disorder, with forefoot adduction only, is referred to as "metatarsus adductus."

Pes Cavus (Fig. 7): This is a hollow foot characterized by elevation of the longitudinal arch and depression of the metatarsal arch.

SUMMARY

1. The technic for obtaining standard views of the infant foot is described.

2. Radiographic criteria for the analysis of the normal infant foot and several congenital abnormalities are presented.

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REFERENCES

1. SCHINZ, H. R., BAENSCH, W. E., FRIEDL, E., AND UEHLINGER, E.: Roentgen Diagnostics, Vol. II: Skeleton (Part 2). English Translation Arranged and Edited by James T. Case. New York, Grune and Stratton, 1951.

2. SHANKS, S. C., AND KERLEY, P., editors: A Textbook of X-Ray Diagnosis by British Authors. Vol. IV. Philadelphia, W. B. Saunders Co., 2d ed., 1950.

3. GOLDEN, R.: Diagnostic Roentgenology. Vol. II. Baltimore, The Williams & Wilkins Co., 1952.

4. LEWIN, P.: The Foot and Ankle: Their Injuries, Diseases, Deformities and Disabilities. Philadelphia, Lea & Febiger, 3d ed., 1947.

5. BANCROFT, F. W., AND MURRAY, C. R.: Surgical Treatment of the Motor-Skeletal System. Vol. I. Philadelphia, J. B. Lippincott Co., 1945.

SUMARIO

Anomalías Congénitas de los Pies

Descríbese e ilústrase la técnica utilizada para obtener radiografías anteroposteriores y laterales destinadas al diagnóstico de las anomalías congénitas más comunes de los pies. Ligeras variaciones de la rotación en una u otra proyección pueden alterar decididamente la relación de los huesos que muestra la radiografía.

Como al nacer el astrágalo y el calcáneo son los únicos huesos tarsianos que estén osificados, el análisis anatómico consiste en el fondo en determinar la relación de esos dos huesos entre sí y con los metatarsianos.

Preséntase una serie de grabados que muestran esas relaciones para el pie normal (Fig. 2), el pie zambo (Fig. 3), la llamada "deformidad en mecedora" (Fig. 4), pie plano (Fig. 5), metatarso varus (Fig. 6) y talipes cavus (Fig. 7).

Evaluation of Placentography in Late Bleeding of Pregnancy[1]

EUGENE J. McDONALD, M.D.[2]

PLACENTA PRAEVIA is present when the placenta is implanted within the zone of the internal os, so as to cover it in whole or in part. Painless bleeding in the last trimester of pregnancy produces fear in the most expert obstetrician. Although less than one-third of such cases of staining or bleeding are due to placenta praevia, its implications and potentialities for morbidity and mortality in both infant and mother make its diagnosis or exclusion most important.

Soft-tissue radiography is a simple, safe, and accurate procedure that requires no special preparation of the patient, no pelvic manipulation, and no injection of an opaque medium. Interpretation of the films requires only understanding, diligence, and observation of all the shadows which are present.

Stallworthy (10, 11) states that in no branch of obstetrics has there been such a dramatic reduction in fetal mortality as in the expectant treatment of placenta praevia. The aim is to reduce fetal mortality due to this cause to below 10 per cent (combined stillbirths and neonatal deaths). It is now in general higher, due to intervention and prematurity.

Bleeding in the last trimester is frequently considered sufficient cause for vaginal examination. The internal os is invaded, with the attendant risks of infection, precipitation of severe hemorrhage, and induction of premature labor. Furthermore, a marginal placenta may be beyond the examining finger and still cause severe bleeding. Also, the cervix is not always patulous and it would not appear justifiable to dilate for diagnosis, especially if simple roentgen methods can be relied upon with confidence (4).

Early diagnosis is important, *first* because the patient is placed in a position favorable for dealing with an emergency prior to its occurrence; *second*, because the cause may be dealt with by an elective procedure, with minimal risk to mother and child. Frequently a diagnosis can be made by films alone and without hospitalization (8).

Anatomically the uterus at term is a flat, pear-shaped organ with the widest diameter at the cornua. Within it the fetus, which is movable, attempts to assume a position to the best advantage, with the back convex and the ventral surface concave. In addition, the uterus contains the amniotic fluid, which amounts to about a quart, and the placenta, which is fixed in position soon after conception, normally above the equator or in the corpus.

The lower uterine segment and cervical areas are not adapted for placentation. These constitute the inactive passage zone between the contractile corpus above and the vagina below. The lower segment is composed largely of elastic tissue and few muscle fibers. It is designed to withstand considerable pressure. The added vascularity with placental attachment in this segment interferes with its normal integrity. The cause of low implantation is not known, but it is definitely associated with multiparity and probably with endometrial disease. The incidence of placenta praevia is difficult to determine, and widely varying figures are given by well qualified observers (3).

At parturition, the average expelled placenta is about 20 cm. in diameter and about 2 to 3 cm. thick. Roentgenographically the placental site appears as a crescentic zone of thickened uterine wall, which should measure close to 7 cm. at its widest or thickest point. Actually the

[1] Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif. Dec. 5–10, 1954.

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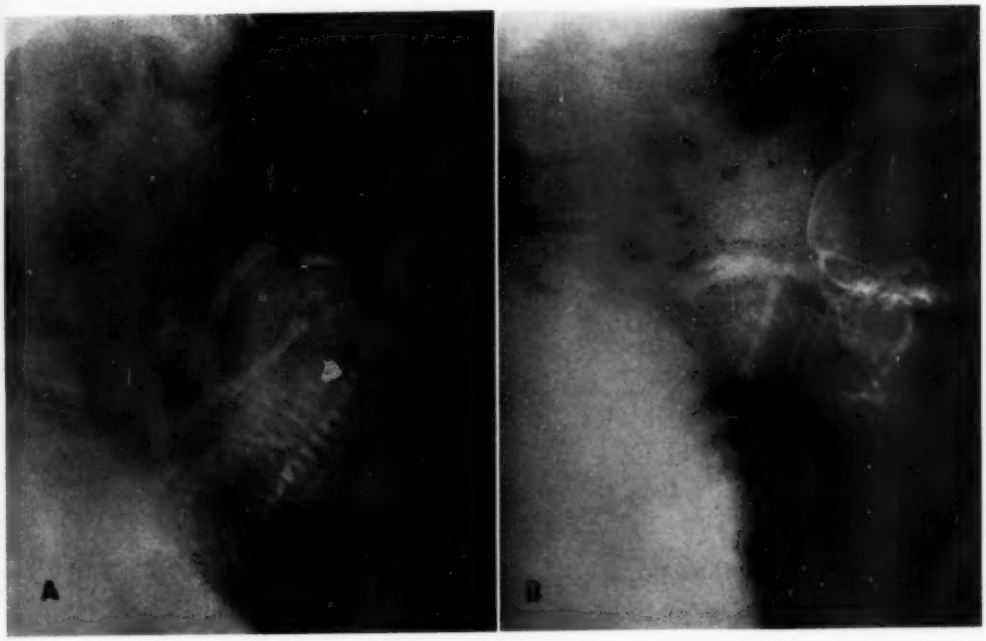

Fig. 1. Normal placental implantation in lateral recumbent views. A. On posterior fundal wall with vertex presentation. B. Posterior cornual-fundal position in term breech presentation.

visualized shadow consists of three components of the same roentgenographic density: first, the normal uterine wall of 1.0 to 2.0 cm.; next, the attached placenta of about 2.0 to 3.0 cm.; finally, amniotic fluid, accounting for the remainder of the density. It should be emphasized that, because of the curved uterine wall, the implanted placenta has a saucer-like form, the concavity of the saucer being filled with amniotic fluid, which casts a shadow of the same density as the placenta and the wall of the uterus (2, 7).

Localization of the placenta should be attempted first on the plain recumbent lateral film. It has been found helpful to draw an imaginary equator transversely through the shadow of the gravid uterus. In general, if the center of the placenta lies above this line, placenta praevia can be excluded. The lower the center lies below the equator, the greater the likelihood of marginal or central implantation. It has been shown that the placenta covers between one-fourth and one-third of the uterine wall. The average cephalocaudal measurement of the term uterus is about 40 cm. and the placental diameter is about 20 cm. More often than not the small parts face the placenta and give rise to easily recognized "digitations," which are due to impressions of the fat-covered knees, elbows, feet, and hands, which cast a less dense shadow between the bones and the amniotic fluid in the saucer-shaped placenta. Calcification, when present, aids greatly but is seldom seen before the fortieth week (9).

Our routine in suspicious cases calls for a conventional lateral recumbent roentgenogram and, when necessary and obtainable, an erect anteroposterior and lateral view. Frequently our patients are bled-out, in labor, or narcotized, or all three. Adequate information is obtained in many instances on the first and simplest view (Fig. 1).

Erect studies are done to take advantage of gravity and thus show the presenting part in its lowest relationship with the inlet. Any lateral or unbalanced displacement is highly suggestive of low implanta-

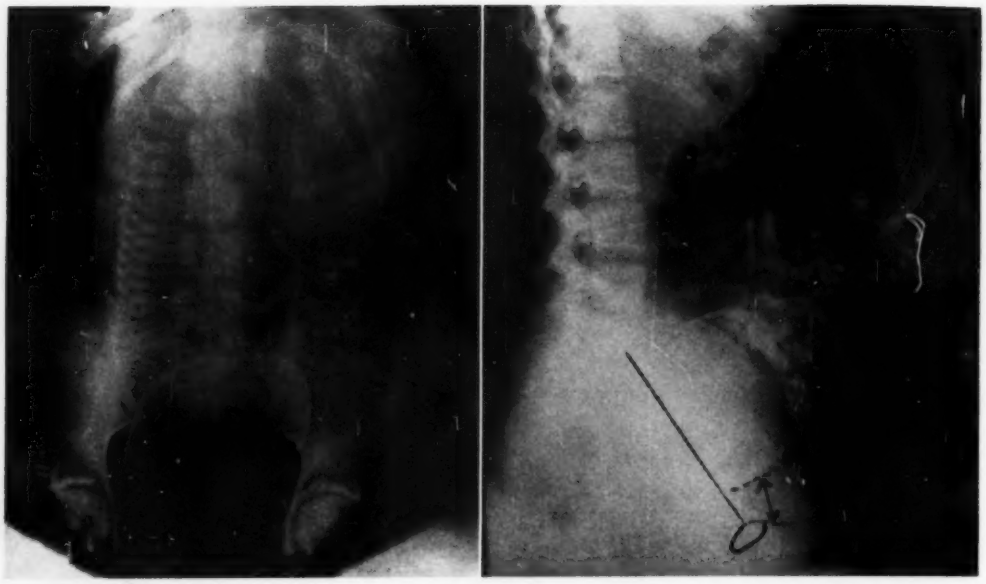

Fig. 2. Low anterior implantation with posterior displacement of head on lateral view but no displacement on frontal view. The margin of this placenta is above the reach of the examining finger for clinical proof but could be the source of dangerous bleeding during dilatation and prior to full effacement of cervix.

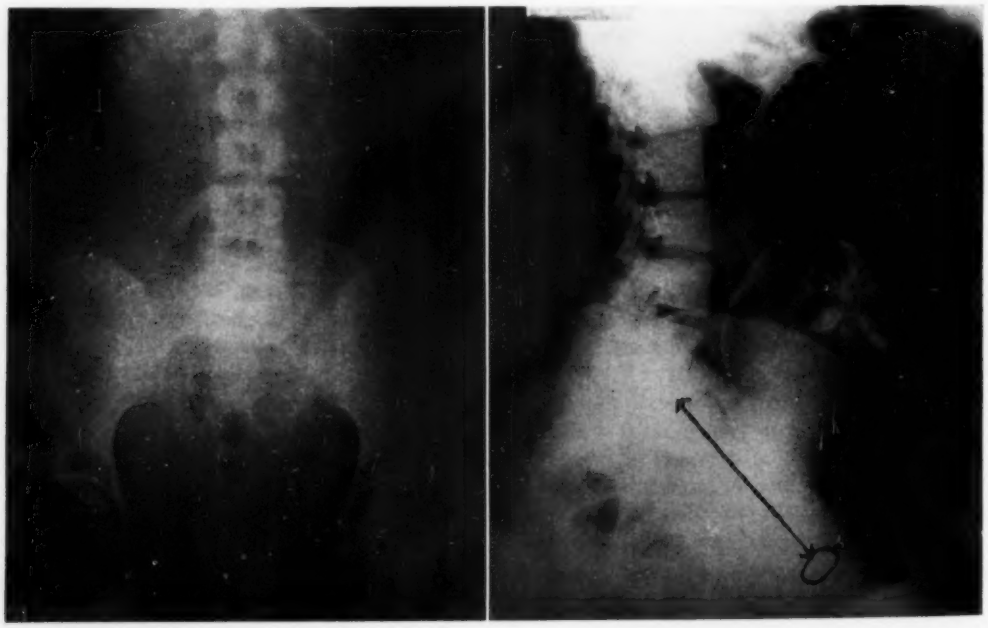

Fig. 3. Nearly complete placenta praevia with upward and lateral displacement on both frontal and lateral projections.

tion. A distended bladder or full rectum must be excluded. Studies by Jacobs (5), Ball and Golden (1), Dippel and Brown (4) in this country, and Reid (8) in Britain, among others, have demonstrated the value and rationale of the erect examination. If the placenta passes through the inlet, it must increase the distance between the presenting part and the brim. The greater the gap, the more likely is placenta praevia to be present. In the erect position, the presenting head lies in the central axis equidistant from the brim margins in both anteroposterior and lateral views. A head-pubis distance of 3.0 cm. or head-promontory displacement of 1.5 cm. or more is consistent with placenta praevia, especially if there is also displacement on the anteroposterior film (Figs. 2 and 3). Admittedly these differences are more conclusive with an engaged head presentation, but with a breech similar studies will demonstrate an asymmetrical displacement if the placenta lies in the lower uterine segment.

Filters to screen out over-penetration of the anterior abdomen have been recommended (14) but after use of one technic at the hospital and the other in the office, under equivalent conditions, it is felt that the filter is unnecessary, although theoretically sound. The technic is much the same as that used in pelvimetry and dependent upon kilovoltage-for-thickness. Both fetal and maternal motion must be eliminated. It should be noted that the placenta acts as a fixed foreign body of similar dimensions within the cavity of the uterus and has a tendency to displace the fetus, requiring it to conform to the remaining space (12). The normal lumbar lordotic curve protruding into the uterine wall may also be considered to act as a foreign body, so that the concave ventral surface of the fetus tends to be against it and produce an occiput anterior. With either high fundal or central praevia position, the internal shape of the uterine cavity is changed from the normal ellipse to a sphere. Since the fetus attempts to accommodate to the most advantageous position, there is no more reason for it to be in a cephalocaudal diameter than transversely or obliquely when the cavity of the uterus approaches a sphere.

Stevenson states that nearly all breech presentations at term show a high cornual-fundal placental implantation. This emphasizes the accommodation theory of fetal position, it being easier for the head, which is smaller than the breech, to lie in the reduced space of the fundus rather than in the pelvis. It is extremely unusual to see a breech presentation at term associated with a placenta praevia. It is common knowledge that transverse positions at term are frequently associated with a central placenta praevia (13).

SUMMARY

In placentography the best results can be expected in making a negative diagnosis, that is, that placenta praevia is not present. Such a diagnosis can be expected to be correct in at least 95 per cent of the cases. This is important, since the obstetrician can safely allow these patients to go to term and deliver vaginally without undue fear of sudden hemorrhage from a placenta praevia.

Poorest results can be expected in low implantation or marginal cases, a correct diagnosis being possible in about 75 per cent. This group of unconfirmed or doubtful cases will require strict supervision.

In any case in which the placenta cannot be visualized in the upper uterine segment, it must be considered to be in the lower uterine segment and is so reported as placenta praevia.

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REFERENCES

1. BALL, R. P., AND GOLDEN, R.: Roentgenologic Sign for Detection of Placenta Praevia. Am. J. Obst. & Gynec. **42**: 530–533, September 1941.

2. BISHOP, P. A.: The Roentgenological Visualization of the Placenta. S. Clin. North America. **25**: 1394–1407, December 1945.

3. DAVIS, M. E., AND CAMPBELL, A.: The Management of Placenta Praevia at the Chicago Lying-In Hospital. Review of 325 Cases During 1931 to 1945. Surg., Gynec. & Obst. **83**: 777–788, December 1946.

4. DIPPEL, A., AND BROWN, W. H.: Direct Visualization of the Placenta by Soft Tissue Roentgenog-

raphy, New England J. Med. **223**: 316–323, Aug. 29, 1940.

5. JACOBS, J. B.: Roentgenography in Obstetrics. Radiology **28**: 406–425, April 1937.

6. MOIR, J. C.: Placentography. 1. A Review of Placentography. Brit. J. Radiol. **26**: 385–387, August 1953.

7. MOIR, J. C.: Fallacies in Soft Tissue Placentography. Am. J. Obst. & Gynec. **47**: 198–211, February 1944.

8. REID, F.: The Radiological Localisation of the Placental Site. I. Normal Implantation. Brit. J. Radiol. **22**: 557–566, October 1949.

9. SIMON, J.: Calcifications placentaires: étude clinique, histologique, et radiologique. Bull. Fed. soc. gynéc. et obst. **3**: 408–417, 1951.

10. STALLWORTHY, J.: The Dangerous Placenta. Tr. Am. A. Obst., Gynec. & Abdom. Surg. **61**: 9–30, 1950.

11. STALLWORTHY, J., ET AL. New Ideas About the Diagnosis and Treatment of Placenta Praevia. Proc. Roy. Soc. Med. **44**: 121–134, February 1951.

12. STEVENSON, C. S.: The Principal Cause of Breech Presentation in Single Term Pregnancies. Am. J. Obst. & Gynec. **60**: 41–53, July 1950.

13. STEVENSON, C. S.: Transverse or Oblique Presentation of the Fetus in the Last Ten Weeks of Pregnancy; Its Causes, General Nature, and Treatment. Am. J. Obst. & Gynec. **58**: 432–446, September 1949.

14. VAUGHAN, C. E., WEAVER, R. T., AND ADAMSON, D. L.: Roentgenographic Visualization of the Placenta, Utilizing Plastic Filter. Canad. M. A. J. **46**: 314–321, April 1942.

SUMARIO

Justipreciación de la Placentografía en la Hemorragia Tardía del Embarazo

La radiografía de los tejidos blandos ofrece un método sencillo, inocuo y exacto para el diagnóstico o la exclusión de la placenta previa. En muchos casos, las radiografías habituales en decúbito lateral permitirán hacer el diagnóstico. Si en esa radiografía se traza un ecuador imaginario a través de la sombra del útero grávido, y se encuentra más arriba del mismo el centro de la placenta, puede excluirse la placenta previa. Mientras más abajo quede el centro de la placenta por debajo de dicho ecuador, más probabilidades hay de implante marginal o central.

La placentografía da sus mejores resultados en la exclusión de la placenta previa. Cabe esperar que ese diagnóstico negativo sea acertado en 95 por ciento de los casos, y el tocólogo puede permitir confiadamente que la gestante prosiga a término y dé a luz vaginalmente sin mayor temor a una hemorragia súbita procedente de una placenta previa. Los peores resultados son de esperar en los casos de implante bajo y marginal. En éstos, el diagnóstico resultará correcto en 75 por ciento aproximadamente. Este grupo de casos dudosos requerirá vigilancia rígida.

En todo caso en que no pueda descubrirse la placenta en el segmento superior del útero, hay que sospechar placenta previa.

Differentiation of Renal Cysts From Neoplasms by Abdominal Aortography: Pitfalls[1]

C. D. CREEVY, M.D., and W. E. PRICE, M.D.

TO DISTINGUISH a solitary (simple, serous) renal cyst from a parenchymal neoplasm is ordinarily easy, requiring a history, physical examination, sedimentation rate determination, and urography. Most solitary cysts give rise to no complaints. They are usually discovered by the patient or physician as rounded, smooth, tense masses in the renal area, or by the radiologist as sharply marginated circular or ovoid shadows adjoining or superimposed upon that of the kidney, in a roentgenogram made for some other purpose. Occasionally, especially in an infant or young child, the cystic nature of a mass may be evident upon transillumination. Renal neoplasms often attract attention because of pain or hematuria, or the presence of a hard or irregular mass. Olovson (9) found the sedimentation rate accelerated in two-thirds of 109 consecutive patients with neoplasms of the renal parenchyma, but observed that it could be normal even in the presence of a large lesion, so that a normal rate is of no significance.

Urography is helpful in differentiating the two conditions. The peripheral cyst may cause no deformity of the collecting system; it usually produces only a little broadening of one or two adjoining calyces, which are smooth and sharply marginated. A centrally placed cyst may distort most or all of the calyces or the whole renal pelvis but, if filling is complete, the margins of the collecting system are sharp and clear-cut. Because pressure from the cyst may prevent complete filling in the excretory urogram, a retrograde pyelogram is more likely to be conclusive.

A renal neoplasm, on the other hand, usually produces a more ragged or irregular calyceal deformity, with a greater tendency to obliteration of calyces or pelvis. However, as Braasch and Emmett (2), Prather (10), and others have emphasized, an encapsulated neoplasm may feel like, and produce exactly the same deformity as, a cyst of similar size. It is when the findings up to this point are inconclusive, that a supplementary method is needed. The question can be settled by surgical exploration, but it is preferable, if possible, to know the diagnosis beforehand, since: (*a*) a neoplasm should be removed with its perirenal fascia and fat intact to minimize the danger of local recurrence, which is certainly increased by cutting or tearing into the tumor; (*b*) nephrectomy should not be done for a resectable cyst; (*c*) a simple cyst causing no symptoms in a debilitated patient should be left alone.

In a symptomless but palpable lesion suggestive of cyst, the diagnosis may often be clinched by diagnostic aspiration and injection of a contrast agent, as recommended by Fish (5) and by Ainsworth and Vest (1). If the resulting shadow in the roentgenogram is sharply marginated, of uniform density, and devoid of filling defects (Fig. 1), the diagnosis of uncomplicated cyst is safe and exploration is unnecessary, particularly in view of the rarity of neoplasms arising within cysts. Gibson (6) has estimated their frequency at 7 per cent.

One may also encounter lesions of doubtful character which are visible on the roentgenogram but not palpable. While Lindblom (7) has had considerable success in aspirating and injecting impalpable cysts under fluoroscopic control, there is danger of over-exposure of personnel and of missing the lesion with the needle. It is here that abdominal aortography (renal angiography) is potentially most useful. Although dos Santos (4) first described this procedure in 1931, and Nelson (8), as well as Doss (3), thereafter repeatedly recommended its use, it was never widely applied until

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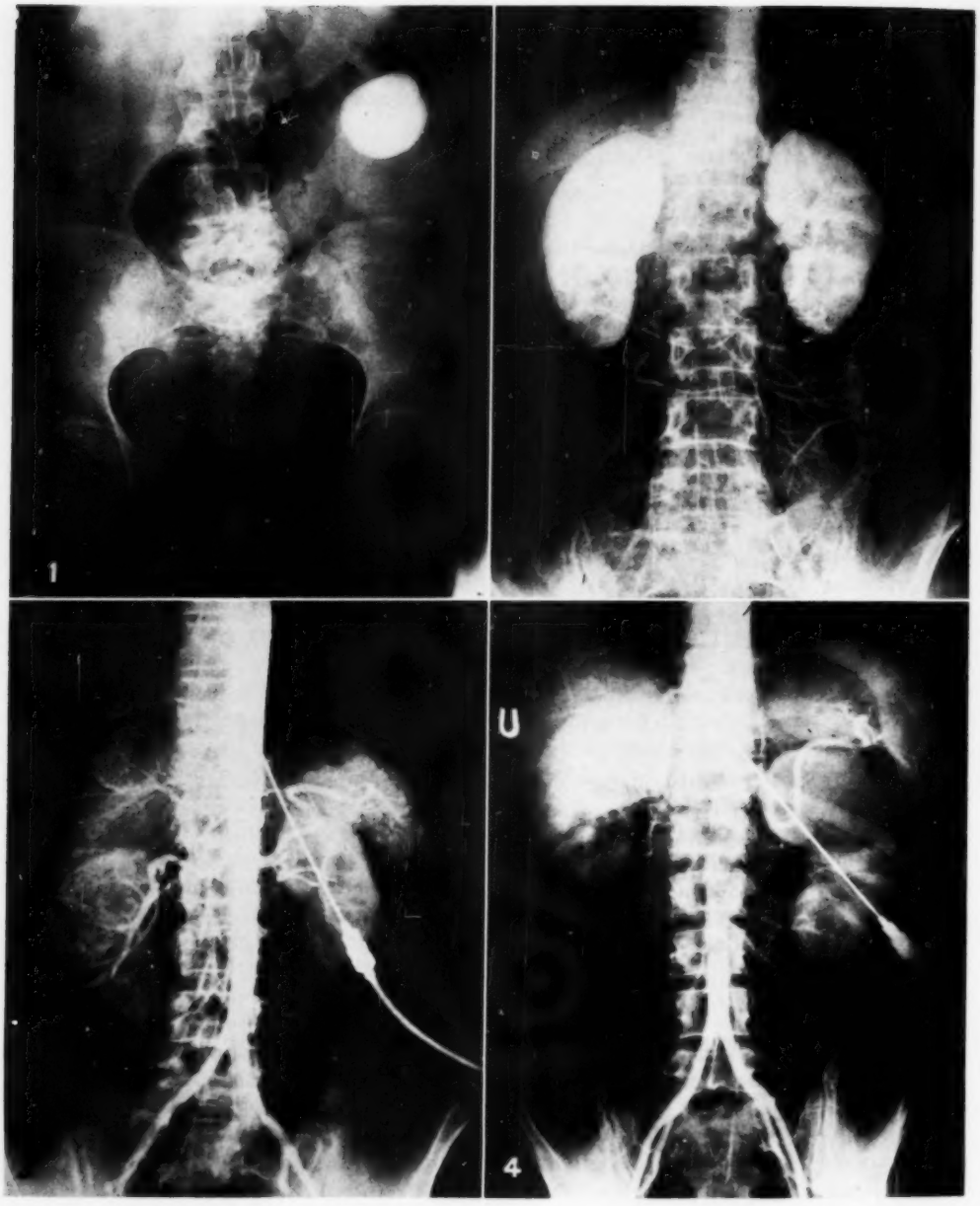

Fig. 1. Injected solitary cyst. Note smooth margin and absence of filling defects.
Fig. 2. Fetal lobulation. This explained a distinct bulge in the convex margin of the kidney in the pyelogram.
Fig. 3. Typical parenchymal neoplasm with "puddling" or tumor staining in the blood vessels.
Fig. 4. Typical solitary cyst of upper pole of left kidney, verified at operation (young man with large mass, recognized by pyelography).

Smith, Rush, and Evans (13) demonstrated in 1952 that it could be employed safely on a large scale. Its value in urological diagnosis depends upon delineation of the nature and extent of the blood supply of the kidney and of a suspected mass.

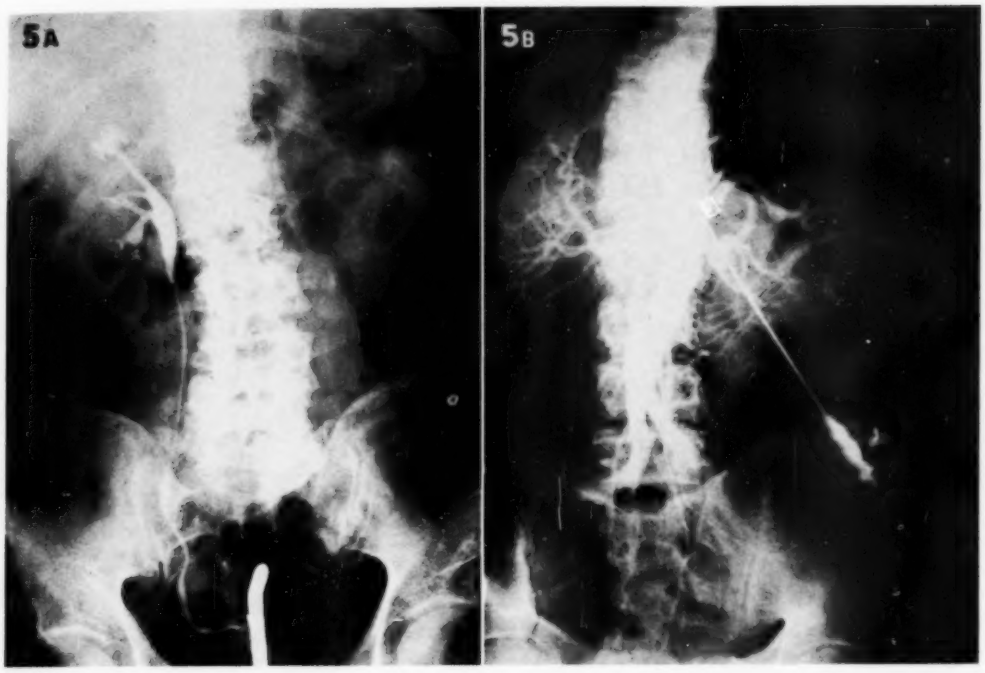

Fig. 5. Pyelogram (A) and aortogram (B). Papillary cystadenocarcinoma within a cyst of the right kidney appears as a simple cyst (patient had multiple metastases). Diagnosis verified by aspiration biopsy.

Its use may aid in determining whether a kidney damaged by disease is worth saving; in demonstrating the size, configuration, and vascularity of a kidney poorly outlined by other methods, as in atrophy, hypoplasia, and hyperplasia; in supplying details not otherwise available concerning congenital anomalies such as accessory renal vessels, polycystic disease, anomalies of form and number, etc. It brings out fetal lobulation in a striking manner (Fig. 2), thus explaining some minor but perplexing pyelographic deformities.

The worth of abdominal aortography in differentiating renal cysts and neoplasms depends upon the striking differences in their vascular patterns. The solid neoplasms of the renal parenchyma (carcinoma, hypernephroma, nephroma, etc.) are characterized by irregularly arranged collections of vascular sinuses of varying caliber, usually described as "puddling" or "tumor staining" (Fig. 3). Unfortunately epitheliomas of the renal pelvis and the rare intracystic papillary cystadenocarcinomas are not sufficiently vascular to show as such in angiograms.

Solitary cysts appear as circular or oval defects in the renal circulation (Fig. 4), which, when typical, are unmistakable. There may be a thin rim of vessels at the periphery of the cyst, but the individual vessel is normal in appearance, lacking the irregular dots and dashes of the parenchymal neoplasm. While Smith (12) has stated that puddling is always present in clear-cell carcinoma, and Scott (11) has said "in our experience aortography is assuming increasing importance in the differential diagnosis" (of renal cysts and neoplasms), our own experience has shown that the renal angiogram is no more dependable than the pyelogram in this respect. Unfortunately, not all renal masses show the typical vascular abnormalities: a parenchymal neoplasm may resemble a cyst, and cysts may present atypical patterns which will confuse the observer.

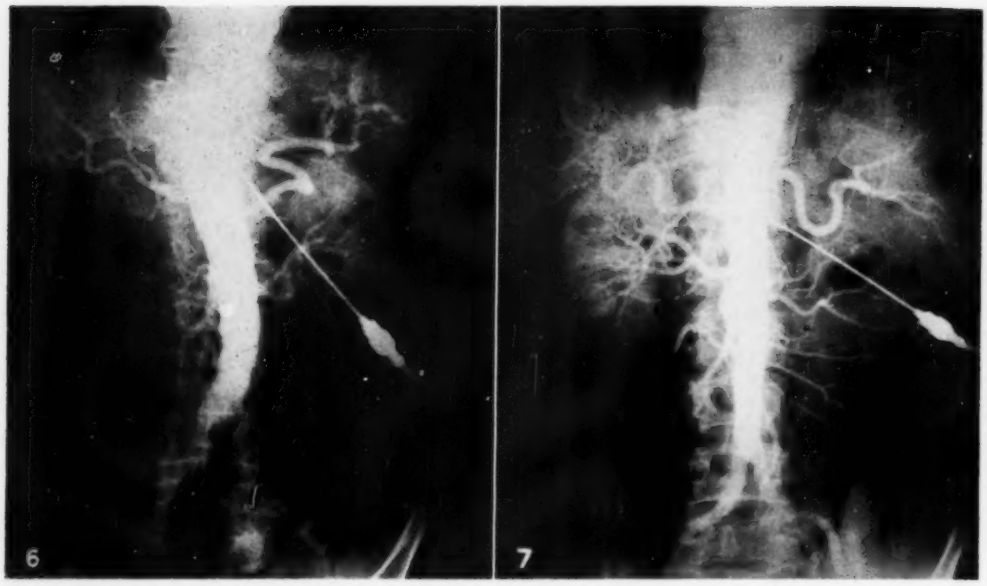

Fig. 6. Complete obliteration of circulation of right kidney by large hypernephroma with local extension and metastases.

Fig. 7. Same changes on left from extensive epithelioma of renal pelvis with local extension and metastases.

Moreover, large neoplasms or their metastases may so compress the renal artery as to prevent delineation of their blood supply. These shortcomings of renal angiography are demonstrated by the following case reports.

CASE I: A patient aged 63 had experienced pain in the right shoulder and had lost several pounds in the few weeks preceding admission. There was a large, smooth, ovoid mass in the right upper and middle quadrants of the abdomen. The sedimentation rate was 79 mm. in an hour (Westergren). Roentgenography showed a poorly marginated patch of destruction in the right upper humerus and multiple rounded shadows in both lungs. Excretory urography disclosed a grapefruit-size mass in the right upper and middle abdomen. The left kidney appeared normal, while the collecting system on the right was displaced medially, and its lateral aspect was somewhat flattened. Aortography showed normal renal vessels; the mass was lateral to the kidney and had no demonstrable blood supply. Since it was clear that extensive malignant disease had metastasized to the humerus and lungs, the abdominal mass was subjected to aspiration biopsy. *Pathologic diagnosis:* papillary cystadenocarcinoma of the kidney (Fig. 5).

CASE II: A man aged 74 complained of acute retention of urine, followed by chills, fever, and hematuria. He had cardiac decompensation due to hypertension and was so obese that abdominal palpation was unsatisfactory. Morphology of the blood was normal, but the sedimentation rate was 113 mm. in an hour. Excretory urography showed a large, poorly outlined mass in the right loin, with obliteration of the psoas shadow. The left kidney appeared normal, but there was no excretion on the right. At cystoscopy the prostate was found to be moderately enlarged; the right ureter was obstructed at 3 cm., so that injected contrast medium ran back into the bladder. Aortography outlined a normal renal blood supply on the left, but there was no evidence even of a renal artery on the right (Fig. 6). Aspiration of the right loin with a large needle recovered neither pus nor abnormal tissue.

Although the patient was digitalized and received adequate treatment with several antibiotics, he continued septic and decompensated, so that surgical exploration was never practicable. He died six weeks after admission, and necropsy revealed a parenchymal neoplasm of the right kidney which practically filled the right half of the abdomen. There were metastases to the regional nodes, lungs, and pleura. Failure of the right renal vessels to fill apparently resulted from compression of the renal artery by the mass.

CASE III: A 56-year-old man was admitted because of multiple ulcerations of the skin of the trunk and extremities. He had long been under observation because of an arsenical dermatosis, previous biopsy of which had shown no evidence of malig-

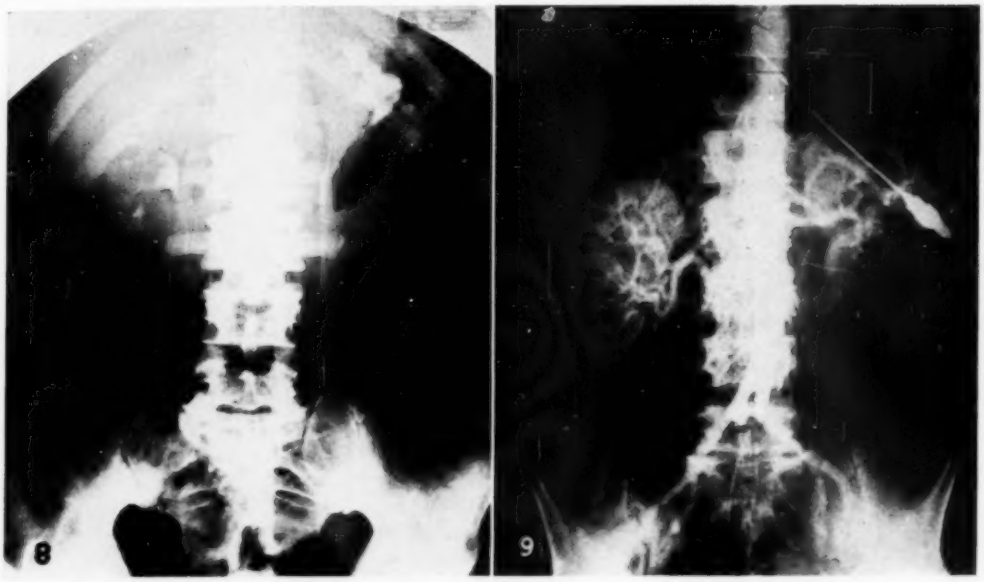

Fig. 8. Parenchymal renal neoplasm with atypical pyelographic deformity.
Fig. 9. Same tumor in aortogram, appearing as an avascular mass, resembling a solitary cyst.

nancy. Shortly before admission, aching in the left loin appeared. Biopsy of several of the cutaneous lesions now showed squamous-cell carcinoma. There was fullness in the left loin, but no mass could be palpated. The urine contained a few white blood cells and a trace of albumin. The peripheral blood was morphologically normal.

On excretory urography the right kidney seemed normal. The left renal shadow was somewhat enlarged and irregular in outline; no contrast medium was seen during one hour. A ureteral catheter was arrested at 3 cm. on the left, and injected contrast agent ran back into the bladder. In the aortogram the right renal circulation appeared normal, but none could be seen on the left (Fig. 7).

For financial reasons, the patient was transferred to the Veterans Hospital, where the left loin was explored and a diagnosis of left renal neoplasm was made. There was an extensive squamous-cell carcinoma of the left renal pelvis, with invasion of the whole ureter, extrarenal extension, and metastases to the regional lymph nodes.

This case simply demonstrates that an extensive carcinoma of the renal pelvis can, like a large parenchymal neoplasm, compress the renal artery and prevent delineation of the kidney and of its lesion. It is worthy of comment that there was an associated severe hypertension in Case II but not in Case III.

In other instances, the renal vessels themselves may fill, but those of a parenchymal neoplasm may fail to do so, presumably because the tumor so compresses its own arteries that the contrast agent follows the path of least resistance, giving a deformity more like that of cyst than of neoplasm. This happened in Case IV.

CASE IV: A male of 48 years was admitted to the neurosurgical service because of severe sacral backache radiating to the posterior thighs. Its severity had increased gradually for several months and had been associated with anorexia and a 20-pound loss of weight. The urine was normal, but there was a moderate secondary anemia and the sedimentation rate was 117 mm. in an hour.

Roentgenograms of the lumbosacral spine showed an area of questionable destruction of the right upper margin of the sacrum; urography (Fig. 8) disclosed upward displacement of the left kidney with clubbing of the calyces and medial displacement of the upper ureter, accounted for by a mass in the lower pole of the kidney. Despite the atypical pyelographic deformity, renal neoplasm seemed the most reasonable diagnosis; nevertheless, an aortogram was obtained (Fig. 9). The renal circulation on each side was normal; on the left was a circular filling defect in the lower pole which corresponded to the upper margin of the mass. Like a cyst, this mass was without blood supply except at the periphery; its appearance would have led to a diagnosis of cyst had it not been for other data (pain, elevated sedi-

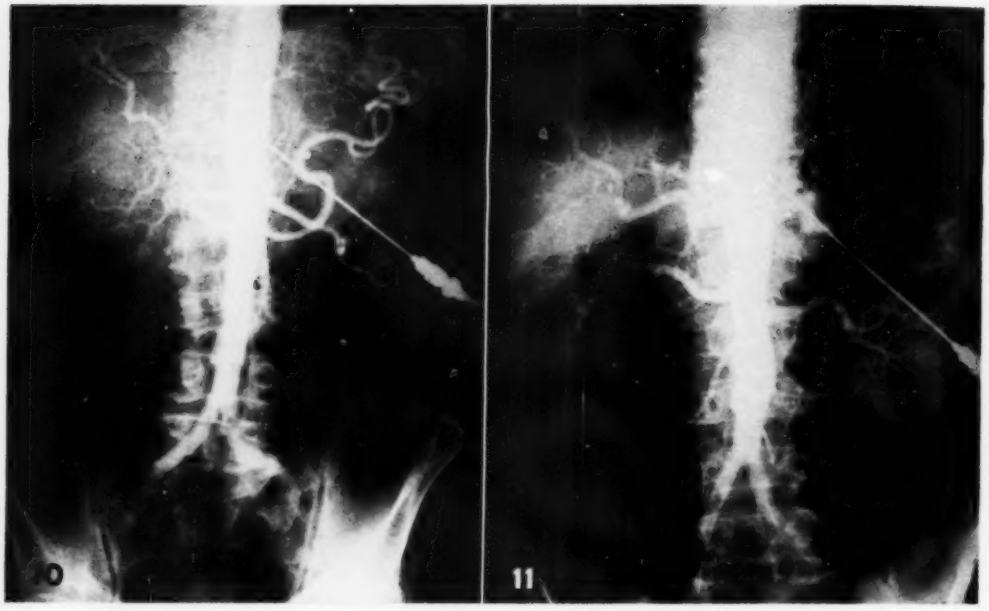

Fig. 10. Mass in lower pole of the left kidney has no blood supply delineated, yet is a malignant parenchymal neoplasm.
Fig. 11. Cyst with unusual vascular pattern.

mentation rate, weight loss, the lesion in the sacrum). The left kidney was removed with its surrounding fat and fascia; the mass in the lower pole was a partly necrotic hypernephroma. Nothing was found except necrosis to account for the absence of typical changes in the renal angiogram.

CASE V: This case is similar in some respects to the preceding one. A man of 64 had suffered from fatigue, weight loss, and weakness for several months. The temperature was 103°F., hemoglobin 9.3 gm., leukocyte count 23,700, and sedimentation rate 124 mm. in an hour. A hard mass was palpable in the left upper and middle quadrants of the abdomen.

Excretory urography delineated normal kidneys on both sides with a round mass attached to the lower pole of the left kidney, but without any deformity of the adjoining calyces. Aortography (Fig. 10) outlined normal kidneys; the mass was visible, but there was no visible blood supply, *i.e.*, no "puddling," the angiogram being typical of cyst rather than of neoplasm. Since this did not agree with the clinical findings, the kidney and mass were removed, the clinical and pathological diagnosis being hypernephroma. Fever, toxemia, and weight loss continued, and death occurred six weeks later. Extensive metastases were found at autopsy.

CASE VI: In a man of 66, gastrointestinal roentgenograms made because of mild dyspepsia revealed a mass just beneath the lower pole of the left kidney. Excretory urograms were a little unsatisfactory, because of obesity, but demonstrated definite broadening and rounding of the lower pole of the left renal shadow, without any definite deformity of the calyces. The sedimentation rate was normal, and there was no anemia. No tumor was palpable. Aortography (Fig. 11) disclosed a round mass expanding the lower pole of the left kidney and showing a rich vascular pattern consisting of a large number of rather conspicuous criss-crossing vessels quite sharply set off from the normal renal vessels and much more numerous than is usual with a cyst. There was no puddling. While the clinical data favored a diagnosis of cyst, the atypical appearance of the angiogram prompted exploration, which revealed a typical solitary cyst within the lower pole of the left kidney. It had no unusual number of blood vessels within its wall, and histologic examination showed no evidence of neoplasm. It may be that the small size of the cyst permitted visualization of the vessels of the renal capsule in addition to those of the cyst wall and thus gave the impression of increased vascularity.

COMMENT

When we first started to use aortography in the study of renal disease at the University Hospital, we were impressed by the striking difference in the appearance of solitary cysts and renal neoplasms, and

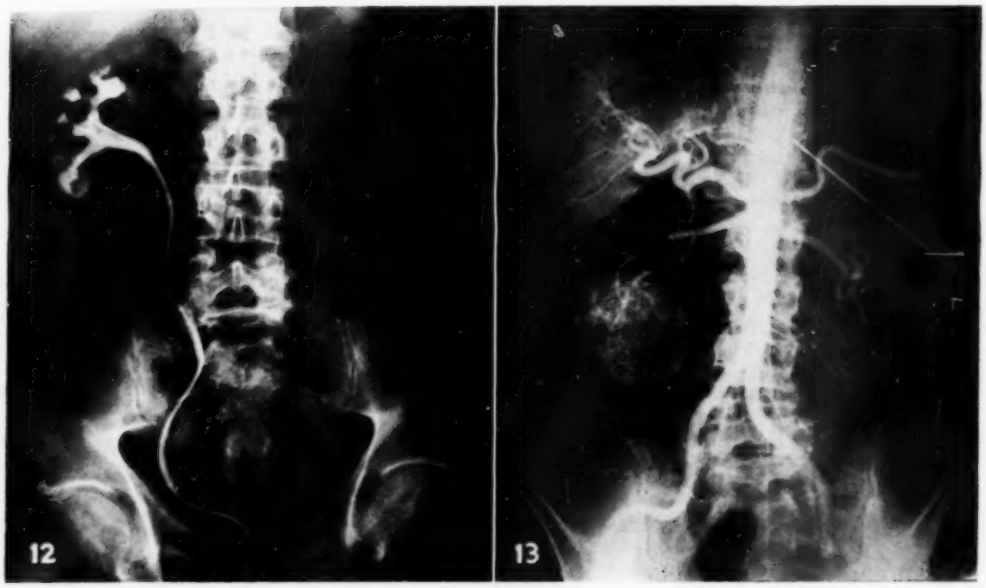

Fig. 12. Atypical pyelogram in large inoperable neoplasm of parenchyma of right kidney.
Fig. 13. Renal angiogram shows the tumor but fails to delineate the large metastatic lymph nodes which were found at operation to have caused the displacement of the kidney.

believed that we could distinguish the two reliably without operation. With increasing experience, however, it has become evident that renal angiography may be just as inconclusive as pyelography in this particular situation, and that it is inferior to the latter in epithelioma of the renal pelvis. Neither procedure is adequate for recognition of the rare papillary intracystic cystadenocarcinoma which with either method produces deformities that are indistinguishable from those of simple cysts. The only dependable non-surgical means of recognizing simple cysts and those containing neoplasms consists in aspirating the cyst and replacing the fluid with a contrast agent; the tumor will appear as a filling defect in the otherwise round, sharply marginated shadow of uniform density usually cast by the contrast agent within the cyst. This method, however, is safe only with palpable masses. There remains, therefore, a small group of lesions in which surgical exploration is necessary to make sure that a neoplasm is not being mistaken for a cyst. The desirability of going as far as possible with the preoperative differential diagnosis in order to plan the operation more effectively has already been emphasized. To press the matter a little further, we have encountered a couple of cases in which it was impossible to differentiate cyst from tumor by palpation of the mass through the perirenal fat and fascia even after the abdominal wall had been incised.

There are two sources of error with renal angiography in the recognition of parenchymal neoplasms: first, the mass may compress the renal artery enough so that the contrast agent, following the line of least resistance, will by-pass the affected area, in which event there will be no visualization of the kidney nor of the tumor. This can occur both with parenchymal and with pelvic neoplasms. Second, the same thing may happen to the arteries of the tumor itself, so that, though the kidney is delineated, the neoplasm is not, and the appearance will be that of solitary cyst.

We do not mean to say that aortography is without value in distinguishing between cysts and neoplasms, but only that it is fallible, as is every other diagnostic technic.

Its value is illustrated by the following case.

CASE VII: A patient aged 54 had pain in the right loin, a large, smooth, hard, kidney-shaped mass in the right half of the abdomen, and hematuria. The sedimentation rate was 101 mm. in an hour. The retrograde pyelogram (Fig. 12) depicted a generalized enlargement of the kidney, with small, sharply outlined, rounded filling defects, like air bubbles, in two of the lower calyces. The renal angiogram, however, was typical of parenchymal neoplasm (Fig. 13). It did not delineate the large involved lymph nodes which overlay the vena cava and displaced the upper pole laterally and downward. Biopsy of this inoperable lesion confirmed the diagnosis of neoplasm.

While atypical aortographic findings did not lead to any serious blunders in the cases just reported, this was because other symptoms and findings pointed to neoplasm. In one instance the unusual appearance of a cyst led to surgical exploration and removal, but this cannot be regarded as a serious error, although one would like to be right as a matter of principle. Nevertheless, since neoplasms can mimic cysts, and *vice versa*, clinically, in the urogram, and in the angiogram, it is important to recognize this possibility so that the use of a relatively new and unfamiliar method will not lead to a sense of false security. It boils down to the familiar precept that one must call upon as many resources as possible in making a diagnosis, never depending solely upon a single piece of evidence.

While Smith, Rush, and Evans have maintained that aortography is innocuous, this cannot possibly be so the country over. We know of two instances of transitory paraplegia, apparently from rapid entrance of contrast agent into the vessels of the spinal cord due to extravasation from the aorta. The dangers of the necessary anesthesia, while slight, cannot be overlooked. In other words, one must weigh the value of the information to be gained from the use of aortography against its small but definite perils before using it.

SUMMARY

While aortography is of undoubted value in the recognition of medical and surgical lesions of the kidneys, it shares with urography, both excretory and retrograde, definite weaknesses in differentiating cysts from neoplasms of the kidney; it fails to delineate epithelioma of the renal pelvis and papillary cystadenocarcinoma within renal cysts. Moreover, parenchymal neoplasms may fail to exhibit characteristic changes in the renal angiogram if the mass or its metastases compress the renal artery, or the arteries to the neoplasm, sufficiently to prevent their delineation by the contrast agent. Therefore, when there is a space-occupying lesion of the kidney which produces atypical changes in the urogram and aortogram, and which is not associated with a clear-cut clinical picture, the conscientious urologist must still explore an occasional kidney to avoid overlooking a neoplasm. The only non-surgical method which permits recognition of an intracystic neoplasm consists of aspiration of the fluid and its replacement with contrast agent, a procedure of limited applicability.

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REFERENCES

1. AINSWORTH, W. L., AND VEST, S. A.: Differential Diagnosis Between Renal Tumors and Cysts. J. Urol. **66**: 740–749, December 1951.
2. BRAASCH, W. F., AND EMMETT, J. L.: Clinical Urography. An Atlas and Textbook of Roentgenographic Diagnosis. Philadelphia, W. B. Saunders Co., 1951, pp. 398, 403, 440.
3. DOSS, A. K.: Translumbar Aortography: Its Diagnostic Value in Urology. J. Urol. **55**: 594–606, June 1946.
4. DOS SANTOS, R., LAMAS, A. C., AND CALDAS, J. P.: Artériographie des membres et de l'aorte abdominale. Paris, Masson et Cie, 1931.
5. FISH, G. W.: Large Solitary Serous Cysts of the Kidney. Report of 32 Cases Including 2 Cases Cured by Aspiration and Instillation of 50 Per Cent Dextrose Solution. J.A.M.A. **112**: 514–517, Feb. 11, 1939.
6. GIBSON, T. E.: Interrelationship of Renal Cysts and Tumors. Report of 3 Cases. J. Urol. **71**: 241–252, March 1954.
7. LINDBLOM, K.: Percutaneous Puncture of Renal Cysts and Tumors. Acta radiol. **27**: 66–72, 1946.
8. NELSON, O. A.: Arteriography in Renal and Abdominal Conditions. J. Urol. **53**: 521–533, April 1945.
9. OLS[illegible] T.: Die Senkungsreaktion beim Hypernephro[illegible]. Erfahrungen von 109 operierten Fällen. Acta [illegible] Scandinav. **93**: 503–512, 1946.
10. PRATHER, G. C.: Differential Diagnosis Between Renal Tumor and Renal Cyst. J. Urol. **64**: 193–199, August 1950.

11. SCOTT, W. W.: Editorial Comment in Yearbook of Urology. Chicago, Yearbook Publishers, 1950, p. 92.
12. SMITH, P. G.: Translumbar Aortography. Tr. Am. A. Genito.-Urin. Surgeons **44**: 129, 1952.
13. SMITH, P. G., RUSH, T. W., AND EVANS, A. T.: Technique of Translumbar Aortography. J.A.M.A. **148**: 255–258, Jan. 26, 1952.

SUMARIO

La Diferenciación de los Quistes de las Neoplasias Renales por la Aotrografía Abdominal: Riesgos

Aunque la aortografía es de valor indudable en el reconocimiento de las lesiones médicas y quirúrgicas de los riñones, comparte con la urografía, tanto excretoria como retrógrada, flaquezas bien definidas en la diferenciación de los quistes de las neoplasias del riñón; no demarca el epitelioma de la pelvis renal y el cistadenocarcinoma papilar incluído en quistes renales. Además, las neoplasias parenquimatosas acaso no manifiesten alteraciones típicas en el angiograma renal si la tumefacción o sus metástasis comprimen la arteria renal, o las arterias que van a la neoplasia, lo suficiente para impedir la demarcación de las mismas por la substancia de contraste. Por lo tanto, cuando existe una lesión que ocupa espacio del riñón y produce alteraciones atípicas del urograma y del aortograma y que no va acompañada de un cuadro clínico bien definido, el urólogo concienzudo tiene todavia que explorar alguno que otro riñón para no pasar por alto una neoplasia.

El único método incruento que permite el reconocimiento de una neoplasia intraquística consiste en la aspiración del líquido y su reemplazo por el medio de contraste, procedimiento este de aplicabilidad limitada.

Preséntanse 6 casos que demuestran las deficiencias de la angiografía renal.

Neoplasia in Children Treated with X-Rays in Infancy for Thymic Enlargement[1]

C. L. SIMPSON, D.M., L. H. HEMPELMANN, M.D., and L. M. FULLER, M.D.

IRRADIATION of enlarged thymus glands in infancy, a practice started by Friedlander in 1907 (1), was commonplace in this country from 1930 to 1945. Since many parents and physicians still firmly believe that thymic enlargement is a potentially dangerous condition, x ray treatments continue to be given to young children with this diagnosis. Because of our interest in possible late sequelae of such x-ray therapy, we have undertaken a survey to determine the present health of 1,722 children treated between 1926 and 1951. Data on the 1,400 children traced to date show that the incidence of malignant neoplasia is high, acute leukemia and thyroid carcinoma being the most common forms of the disease. The high cancer rate in the treated groups is significantly above that in 1,795 untreated siblings and in the general population of the same age distribution.

Although the medical literature contains numerous warnings about the possible dangers of the widespread and indiscriminate use of x-rays in the treatment of enlargement of the thymus gland, no concrete substantiating evidence has been presented. Duffy and Fitzgerald (2) suggested a possible association between thyroid cancer in childhood or adolescence and prior irradiation to the thymus gland. In 10 of their series of 28 cases of carcinoma of the thyroid there was a history of x-ray treatment. Two subsequent papers reviewing other series of childhood cancers of the thyroid do not report a history of irradiation (3, 4). Recently Dameshek (5) commented that in one month he had seen 3 children with leukemia who had received roentgen therapy to enlarged thymus glands.

Previous attempts to follow children who had received x-ray therapy for thymic enlargement are limited in number and scope. In 1936, Polk and Rose (6) reported a study on 31 of 55 children treated before 1924. Only 18 of the children were less than eighteen months old when treated. One child died of leukemia, but this was only two weeks after treatment. In 1938, Kerley (7) noted that 27 patients were mentally and physically normal twenty-six weeks to sixteen years after irradiation. Conti and Patton (8) reported on a series of 7,400 consecutive newborn infants seen between 1937 and 1946. In the early part of their study, the 3 to 4 per cent of infants found to have roentgen evidence of thymic enlargement were given x-ray therapy whether or not they had symptoms. Later all infants received small doses of x-rays. As this appeared to increase the incidence of respiratory disease, prophylactic roentgen treatments were discontinued. These authors did not observe any cases of neoplasia in their follow-up study, which, however, included only one third of the cases and lasted only a few years for each child.

MATERIAL

Our 1,722 treated cases were taken from the records of three hospitals and from one pediatric and two radiological practices. The majority came from western New York and the rest from the State of Washington. They include all children in these practices known to have had treatment for enlarged thymus glands prior to 1951. Three hundred and ninety-two patients were treated before 1935, 983 between 1936 and 1945, and 347 since 1946.

[1] From the division of Experimental Radiology and Radiation Therapy, University of Rochester School of Medicine and Dentistry, Rochester, N. Y. Part of the work was carried out when the senior author was Instructor in Pathology at the University of Washington, Seattle. The study was supported, in part, by a grant from the Atomic Energy Commission. Accepted for publication in July 1954.

TABLE I: DISTRIBUTION OF NEOPLASIA ACCORDING TO TREATMENT GROUP

Treated		Traced	Dead	Leukemia	Thyroid Cancer	Other Cancer	Thyroid Adenoma	Osteochondroma
Group A:	232	206	23	1	0	0	1	0
Group B:	343	283	8	1 (?2)	0	0 (?1)	2	0
Group C:	268	218	10	2	3	3	5	3
Group D:	424	343	10	2	0	1	1	0
Group E:	302	215	10	1	2	0	0	1
Group F:	153	135	6	0	1	0	0	0
TOTAL	1,722	1,400	67	7 (?8)	6	4 (?5)	9	4
Untreated siblings		1,795	56	0	0	5	1	0

The type of case varied considerably from group to group. In one hospital the majority of children had respiratory symptoms at the time of treatment. In the two other hospitals, all newborn babies were screened for thymic enlargement before discharge. Most of the children in these groups were asymptomatic and less than two weeks old at the time of treatment. In the other practices, a considerable number of patients were also asymptomatic but were treated at the age of several weeks or months. Very few children were as old as one year when therapy was administered.

The children have been divided into six groups (Table I) on the basis of the radiation technic used. The plan of treatment remained fairly constant within each of the first five groups except for a general tendency to lower the dosage in the later years of study. Group F is a miscellaneous collection and, in a substantial portion of the cases, details of treatment are unknown. X-rays of high voltage (200–220 kv) were used in Groups A and B and of intermediate voltage (110–130 kv) in Groups C, D, and E. Port sizes were generally 10.5 × 7.5 cm. in Group D, at least 9 × 9 cm. in Group C, and 6 × 8 cm. in Group E. In Groups A and B the ports were variable before 1938, being as large 15 × 15 cm. on occasion. After that date they were 6 × 8 cm. When more than one treatment was given, the interval was generally two days except in Group C, where the standard procedure was two to three treatments at ten- to fourteen-day intervals. Filters showed considerable variation. Total dose (in air) ranged from 50 to 1,500 r, with the great majority being less than 600 r. In general, Groups C and D received the highest total doses. Roentgen doses for cases treated prior to 1935 have been estimated from the known radiation factors. Six hundred and four children are known to have received 200 r or less and 804 children more than that dose. In 314 cases, insufficient data are available to make this division.

Records regarding fluoroscopies are incomplete, and it is certain that repeated examinations would have added substantially to the exposure dose, as was shown by Buschke and Parker (9). Several of the children are known to have received irradiation for other conditions. In the case of one girl with thyroid cancer (Case 8), this is estimated to have amounted to 3,100 to 4,300 r delivered to the region of the thyroid gland.

METHODS

The survey was conducted by questionnaire. Since the questions had to be worded carefully in order to avoid anxiety, answers were not always ideal. The information was supplemented, however, by records of physicians, hospitals, and the State Department of Health. In particular, the municipal and State cancer files were checked for all untraced children and possible siblings. A few of the patients were seen personally. Confirmation of the diagnosis was obtained from reliable sources in all but 2 cases of malignant disease and in all but 1 case of thyroid adenoma. Most of the histologic prepara-

TABLE II: CASES OF MALIGNANT NEOPLASIA

Number	Sex	Disease	Age of Onset	Course
			Treated Cases	
1	F	Subacute lymphatic leukemia	1 year	Died within 18 months
2	F	Acute lymphatic leukemia	7 years	Died within 6 months
3	M	Subacute lymphatic leukemia	14 years	Died within 6 months
4	M	Acute stem-cell leukemia	12 years	Died within 6 months
5	M	Acute lymphatic leukemia	5 years	Died within 6 months
6	M	Acute stem-cell leukemia	5 years	Died within 6 months
7	M	Acute lymphatic leukemia	5 years	Died within 6 months
8	F	Thyroid carcinoma	17 years	Alive without recurrence 3 years after resection of primary tumor and lymph node metastases
9	F	Thyroid carcinoma	16 years	Alive without recurrence a year after resection of primary tumor and lymph node metastases
10	M	Thyroid carcinoma	10 years	Alive without recurrence 3 years after resection and x-ray therapy
11	M	Thyroid carcinoma	9 years	Alive 6 years after excision of primary tumor and lymph node metastases. Lung metastases controlled by I^{131} for last 4 years
12	M	Thyroid carcinoma	6 years	Alive 10 years after resection of primary tumor. No recurrence
13	M	Thyroid carcinoma	8 years	Alive 10 years after resection of primary tumor. Lung metastases for 8 years. No longer completely controlled by treatment
14	F	Neurogenic sarcoma of skin of back	2 years	No recurrence 18 years after resection and x-ray therapy. Adenoma of thyroid removed at 19 years of age
15	M	Fibrosarcoma of tonsil	10 years	Died of tumor within 6 months
16	M	Atypical chordoma in skull	18 years	Alive 4 months after partial resection
17	M	Reticulum-cell sarcoma of femur	10 years	Died in a few months of widespread disease
18	F	? Acute stem-cell leukemia	5 years	Died in a month in 1935, with diagnosis uncertain between infectious mononucleosis and leukemia
19	F	? Brain tumor	2 years	Died 3 days after onset; histologic preparations lost; might be granuloma
			Untreated Siblings	
20	M	Hodgkin's disease	25 years	Died within a year of onset
21	M	Neurosarcoma of optic nerve	22 years	Died within a year of onset
22	M	Pericytoma of foot	15 years	Alive without recurrence 8 years after excision and x-ray treatment
23	F	Embryonic sarcoma in pelvic tissues	3 months	Dead within a month
24	F	Retroperitoneal neuroblastoma	2 years	Died within a year

TABLE III. DISTRIBUTION OF NEOPLASIA ACCORDING TO AMOUNT OF RADIATION

	Under 200 r	Over 200 r	Unknown
Number treated	604	804	313
Cases of leukemia	3	4	(?1)
Other cancers	0	4	0
Carcinoma of thyroid	0	6	0
Adenoma of thyroid	0	6	3

tions were reviewed by the authors. The 2 unsubstantiated cases, a stem-cell leukemia and a brain tumor, were not included in the statistical analyses.

The expected cancer incidence was calculated from the tables of the New York State Bureau of Health (1949–51) (10), using the concept of person-years-at-risk in each age period. Appropriate adjustments were made for the changing incidence of leukemia (Cooke 1954) (11). For statistical analyses the Poisson distribution tables or the X^2 test were used, whichever was appropriate.

RESULTS

The present status of health has been determined for 1,400 (81 per cent) of the 1,722 treated cases and for 1,795 of their untreated siblings. A considerable number of siblings were excluded from the series because they were alleged to have had x-ray therapy. Sixty-seven treated

children and 56 untreated siblings have died. Seventeen (possibly 19) children of the treated group have had some form of cancer, 9 of them being dead. Four of the untreated siblings have died of cancer and 1 other has had a malignant tumor removed. The types of cancer are listed in Table II, along with the age and sex of the child and the course of the disease. In addition to the cases listed in the table, 6 children (3 males, 3 females) have had partial thyroidectomy for adenomas, and 2 boys are awaiting operations for solitary thyroid nodules. Only 1 untreated sibling has had a thyroid adenoma.

Among the other forms of neoplasia noted in the treated group are 4 cases of osteochondroma (exostoses) of the upper extremity. One treated child and 1 sibling have had a neuroma removed from the arm and foot respectively, and 1 treated child died in infancy of complications resulting from an extensive hemangioma of the diaphragm. Other children have had small benign hemangiomas and lymphangiomas.

The distribution of the cases of neoplasia among the treatment groups is shown in Table I. Table III shows the distribution according to the total roentgens delivered to the skin. Whereas the cases of leukemia appear to be evenly distributed among the groups in both Tables I and III, the majority of the other forms of neoplasia occur among the 268 children in Group C and among those known to have received more than 200 r.

The expected and observed cancer incidence among the treated children and their siblings is shown in Table IV.

TABLE IV. EXPECTED AND OBSERVED RATES FOR MALIGNANT NEOPLASIA

	Treated Children		Untreated Siblings	
	Expected	Observed	Expected	Observed
All cancers	2.6	17 (?19)	2.7	5
Leukemia	0.6	7 (?8)	0.6	0
Thyroid cancer	0.08	6	0.08	0

SIGNIFICANCE OF THE DATA

A serious limitation to the interpretation of these data is the absence of a proper control group of untreated infants with enlarged thymus glands. Certain conclusions can be reached, however. The untreated siblings provide a control group in which the cancer incidence has been obtained in the same manner as was that of the treated group and in which the genetic and environmental background is similar. Records reveal that in many of these children enlargement of the thymus was excluded by examination, but in the majority the condition of the gland is unknown. There is also a major objection to using the figures for cancer incidence in the general population for comparative purposes because of the different manner in which the figures are obtained. There is known to be a considerable degree of under-reporting to the State Cancer Bureau, and this is most marked in childhood cancer (12). This is of relatively little importance in the case of rapidly fatal forms such as acute leukemia but is a serious defect in reckoning the incidence of non-fatal cancers and those, such as carcinoma of the thyroid, with a long natural history.

The data show that the children who received x-ray treatment for enlargement of the thymus have a high incidence of neoplasia, particularly of leukemia and of tumors of the thyroid gland, and that this incidence is not uniform among the different groups investigated. Statistical analyses confirm these impressions: First, the rate of malignant disease is significantly higher in the treated group than in the siblings ($p < 0.05$) or the general population ($p < 0.001$). Second, the number of cases of leukemia and of thyroid cancer is significantly higher in the treated group than among either the untreated siblings or the general population ($p < 0.01$ in each instance). Third, the occurrence of almost half the cases of malignant disease in Group C is greater than one would expect on the basis of chance ($p < 0.05$). The propor-

tion of cancer cases among children who received over 200 r is also not likely to be due to chance (p less than 0.01).

It should be emphasized here that, in order to avoid bias due to our methods of follow-up, all untraced children have been regarded as alive and well for purposes of statistical analyses. It must also be noted that the incidence of cancer among the untreated siblings is high compared with the general population. The possibility of 5 cases occurring by chance is about 1 in 7. Attention has already been drawn to a possible explanation of this fact in the different methods used to obtain the figures for cancer incidence.

The incidence of benign tumors can only be compared with that in the siblings, as no figures are available for the general population. However, it is felt by clinicians in this area that the incidence of thyroid adenoma is definitely higher, and of exostosis probably higher, than normal. Certainly the incidence of thyroid adenomas among our treated children is significantly higher than in the untreated siblings (p less than 0.001).

DISCUSSION

While the data presented establish the high incidence of cancer following thymic irradiation, they allow no definite conclusions to be drawn as to the relationship to the radiation exposures. This is particularly true of leukemia, which was apparently not associated with any one form of treatment or with high radiation doses. It is possible that the children covered by this study are especially prone to develop leukemia. Efforts are being made to obtain an adequate control series to investigate this possibility. If it is not supported, then radiation exposure, even at the low doses used, must fall under suspicion, since the leukemogenic action of radiation has been firmly established in man and animals (13, 14).

In the case of the other neoplasms, in particular of the thyroid, a high correlation exists between the form of treatment and the disease, and therefore radiation must be suspected as a possible factor in the etiology. Although previous studies on adults treated for hyperthyroidism with x-rays have not revealed an increased cancer rate (15), radiation has been shown to produce thyroid cancer in animals (16); its action in producing other types of tumor is also well known. There is, however, an intriguing possibility that this is an indirect effect in view of the relationship between the thymus, the thyroid, and the thyroid-stimulating hormone of the pituitary (17).

SUMMARY

A study has been made of the subsequent history of 1,400 of 1,722 children who received x-ray therapy to the thymus gland between 1925 and 1951. In 17 of these children malignant neoplasia is known to have developed, including 7 cases of leukemia and 6 of carcinoma of the thyroid. This is a significantly higher incidence than was found among the untreated siblings of the irradiated children or in the general population. In addition, 9 treated children were found to have thyroid adenoma.

A relationship has been shown between both the total malignant tumors and the thyroid neoplasia incidence and the type of treatment given. No such relationship could be demonstrated in the case of leukemia. The possible significance of these facts has been discussed.

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REFERENCES

1. FRIEDLANDER, A.: Status Lymphaticus and Enlargement of the Thymus with a Report of a Case Successfully Treated by the X-Ray. Arch. Pediat. **24**: 490–501, 1907.
2. DUFFY, B. J., JR., AND FITZGERALD, P. J.: Thyroid Cancer in Childhood and Adolescence. Report on 28 Cases. Cancer **3**: 1018–1032, November 1950.
3. HORN, R. C., JR., AND RAVDIN, I. S.: Carcinoma of the Thyroid Gland in Youth. J. Clin. Endocrinol. **11**: 1166–1178, October 1951.
4. WARREN, S., ALVIZOURI, M., AND COLCOCK, B. P.: Carcinoma of the Thyroid in Childhood and Adolescence. Cancer **6**: 1139–1146, November 1953.
5. DAMESHEK, W.: The Outlook for the Eventual Control of Leukemia. New England J. Med. **250**: 131–139, Jan. 28, 1954.
6. POLK, D. S., AND ROSE, E. K.: Late Effects of Irradiation of the Thymus. Am. J. Roentgenol. **36**: 498–501, October 1936.
7. KERLEY, C. G.: End-Results of Irradiation of the Thymus Gland in Twenty-Seven Normal Infants and Children. Am. J. Roentgenol. **40**: 416–417, September 1938.
8. CONTI, E. A., AND PATTON, G. D.: Study of the Thymus in 7,400 Consecutive Newborn Infants. Am. J. Obst. & Gynec. **56**: 884–892, November 1948.
9. BUSCHKE, F., AND PARKER, H. M.: Possible Hazards of Repeated Fluoroscopies in Infants. J. Pediat. **21**: 524–533, October 1942.
10. Annual Average Cancer Incidence Rates, New York State (exclusive of New York City) 1949–1951, Department of Health, Division of Medical Services, Bureau of Cancer Control, Albany, New York.
11. COOKE, J. V.: The Occurrence of Leukemia. Blood **9**: 340–347, April 1954.
12. HANDY, V. H.: Personal communication, 1954.
13. KAPLAN, H. S., AND BROWN, M. B.: Protection Against Radiation-Induced Lymphoma Development by Shielding and Partial-Body Irradiation of Mice. Cancer Res. **12**: 441–444, June 1952.
14. FOLLEY, J. H., BORGES, W., AND YAMAWAKI, T.: Incidence of Leukemia in Survivors of the Atomic Bomb in Hiroshima and Nagasaki, Japan. Am. J. Med. **13**: 311–321, September 1952.
15. QUIMBY, E. H., AND WERNER, S. C.: Late Radiation Effects in Roentgen Therapy for Hyperthyroidism. Possible Bearing on Use of Radio-active Iodine. J.A.M.A. **140**: 1046–1047, July 23, 1949.
16. DONIACH, I.: The Effect of Radioactive Iodine Alone and in Combination with Methylthiouracil Upon Tumour Production in the Rat's Thyroid Gland. Brit. J. Cancer **7**: 181, June 1953.
17. RAWSON, R. W., AND MONEY, W. L.: In Recent Progress in Hormone Research, Gregory Pincus, Editor. New York, Academic Press. Vol. 4, 1949, p. 397.

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SUMARIO

Neoplasias en Niños Tratados con Rayos X en la Infancia por Hipertrofia Tímica

Este estudio versa sobre la historia subsiguiente de 1,400 de 1,722 niños que recibieron roentgenoterapia en el timo entre 1925 y 1951. En 17 de esos niños, se sabe que apareció neoplasia maligna, comprendiendo 7 casos de leucemia y 6 de carcinoma del tiroides. Esta es una incidencia significativamente mayor que la observada entre los hermanos no tratados de los niños irradiados o entre la población general. Además, se descubrió que 9 niños tratados tenían adenoma tiroideo.

Se descubrió una relación entre la incidencia tanto total de tumores malignos como de neoplasias tiroideas y la forma de tratamiento administrada. No pudo descubrirse tal relación en lo tocante a la leucemia.

The Roentgen Findings in Adenomyosis[1]

RICHARD H. MARSHAK, M.D., and JOAN ELIASOPH, M.D.

ADENOMYOSIS IS defined as the heterotopic occurrence of islands of endometrium within the myometrial layer of the uterine wall. Its detailed histopathology was first described by Rokitansky (8) in 1860. Von Recklinghausen (7), in 1896, in a monograph on the subject, identified these endometrial inclusions in the wall of the uterus as misplaced embryonal remnants derived from the mesonephros or wolffian body. Cullen (2), in 1908, utilizing serial sections, demonstrated in 56 of 73 cases studied, an anatomical continuity between the endometrium and the intramural "islands" of endometrial elements. It was subsequently demonstrated that a tubular communication could be identified in all cases provided the adenomyotic glands were located in the inner third of the uterine wall. Where endometrial implants were present in the outer muscle wall, no continuity was demonstrable (1).

PATHOLOGY

The uterus is usually slightly enlarged—in extreme cases to as much as five times its normal weight—in the absence of other disease. This enlargement is attributed to hyperplasia of the myometrium in the region of the implants. Ordinarily the thickening is uniform, but it may be irregular in those instances where the implants are irregularly distributed. There is a frequent association with pelvic endometriosis, including endometrial implants on the serosal surface of the uterus. The endometrium is usually smooth. On occasion, pit-like depressions, representing the openings of the adenomyotic channels, are seen. In approximately 10 to 15 per cent of cases there is endometrial hyperplasia (3).

The cut surface (Fig. 1) shows whorl-like condensations of muscle surrounding tiny pale translucent areas which consist of uterine mucosa. Occasionally these central areas are cystic, measuring from 1 to 9 mm. in diameter and containing blood and desquamated epithelium. These central areas may contain chocolate-colored material resulting from menstrual hemorrhage, analogous to the chocolate fluid in endometrial cysts of the ovaries. Associated leiomyomas are frequently seen, occurring in 30 to 70 per cent of the reported cases (3). In this series their incidence was 20 per cent (Fig. 10).

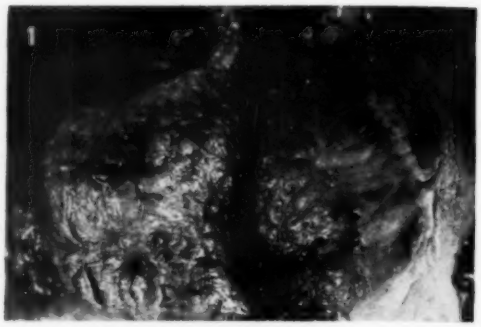

Fig. 1. Cut surface of the uterus showing endometrial channels surrounded by whorl-like condensations of muscle in the thickened myometrium. A number of small cystic areas containing blood can be seen.

Microscopically (Figs. 2 and 3), islands of endometrium comprising epithelial, glandular, and stromal elements surrounded by hyperplasia of the adjacent smooth musculature are seen. These are not set off from the adjacent tissue by a capsule or basement membrane but lie free in the smooth muscle interstices. When they are located in the superficial layers of the myometrium, duct-like communications with the endometrial surface are readily demonstrated by serial section. The diameter of the channels may vary from not more than a hair breadth to as

[1] From the Department of Radiology, The Mount Sinai Hospital, New York, N. Y. Accepted for publication in May 1954.

Fig. 2. Low-power view of the uterine wall reveals an endometrial channel dipping deeply into the myometrium from the endometrial surface. Extensive adenomyosis is seen in the adjacent musculature.

Fig. 3. Low-power view of the uterine wall reveals a large endometrial channel within the myometrium. The endometrial layer is normal.

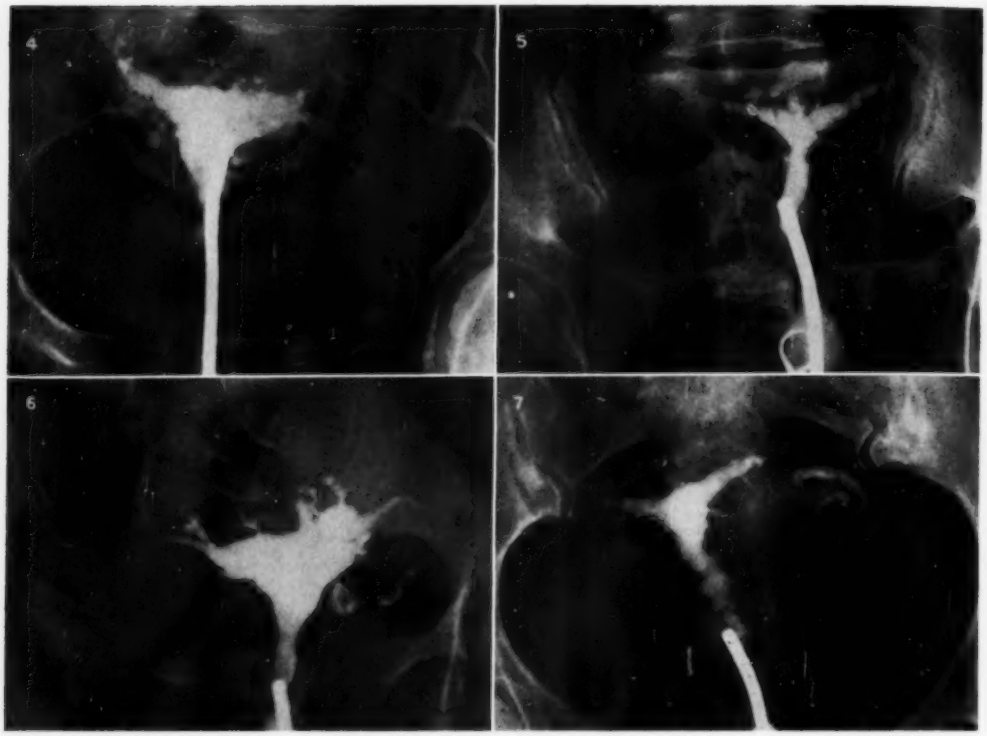

Fig. 4. The uterine cavity is slightly enlarged. Numerous projections are seen extending from the walls of the uterine cavity. Most of them terminate in small sacs. There is no evidence of any organic filling defect. Impression: Adenomyosis.

Fig. 5. The uterine cavity is slightly smaller than is usually noted, with a slight irregularity of contour due to endometrial hyperplasia. Several large sacs are seen extending from the superior surface. Impression: Adenomyosis with slight endometrial hyperplasia.

Fig. 6. The uterine cavity is slightly enlarged. Numerous spicules ending in small sacs are seen extending from the surface of the uterine cavity, especially from its superior aspect. Slight branching is noted. Impression: Adenomyosis.

Fig. 7. The uterine cavity is normal in size, shape, and position. Many small projections are seen extending from the lateral wall. Other tiny projections are noted on the superior wall. There is slight irregularity of the contour of the cavity due to endometrial hyperplasia. Impression: Adenomyosis and slight endometrial hyperplasia.

much as 5 mm. The tubular glands pursue a branching tortuous course, winding in all directions, but always directed toward the serosal surface, running between muscle bundles.

Adenomyosis of the cervix is uncommon. When present, the glands and stromal elements are those that are found in the body of the uterus.

ROENTGEN FINDINGS

The pathological findings described produce the following roentgen changes. The uterine cavity may be normal in size, or slightly or moderately enlarged. Considerable enlargement of the uterine cavity is usually associated with the presence of intramural or submucous fibroids. The most striking diagnostic feature is the demonstration of short, spicule-like structures extending perpendicularly from the borders of the uterine cavity, varying in length from 1 to 4 mm. In approximately 30 per cent of the cases, the projections end in small sacs, varying from 2 to 4 mm. in diameter. On occasion the spicules are considerably elongated, measuring from 1 to 2 cm. in length, and present a circuitous or undulating course. Although branching is seen occasionally on

microscopic sections, it is rarely noted on the hysterogram.

This spiculation is not a constant finding. It was noted only 38 times in 150 cases of proved adenomyosis in which hysterography was performed. Twelve of these cases were reported in a previous communication (4). It is especially noted when water-soluble media are used. The failure of Lipiodol, Iodochloral, and other oily media to enter the tiny channels may be explained on the basis of the high surface tension and increased viscosity of these materials. Another possible cause for the failure of the radiopaque material to enter the endometrial channels is the marked overgrowth of muscle, which may act as a pinchcock, or possibly the presence of clotted blood or secretions. Desquamated epithelium in the interior of these channels secondary to the menstrual slough may be a contributing factor.

When adenomyosis of the uterus is associated with marked endometrial hyperplasia, the roentgen findings of the latter are also noted. There is indistinctness of the margins of the uterine cavity and multiple small, usually smooth, filling defects due to endometrial polyps can be delineated. When the endometrial hyperplasia is very extensive, the opaque material may be prevented from entering the endometrial channels.

In 4 cases in this series a slightly enlarged uterine cavity with a smooth globular filling defect, suggesting a submucous fibroid, was noted. At operation no submucous fibroid was found. There was, however, tremendous growth of the uterine musculature. This probably accounts for the filling defect, permitting the contrast medium to outline only the periphery of the uterine cavity, producing the described roentgen changes (Fig. 11).

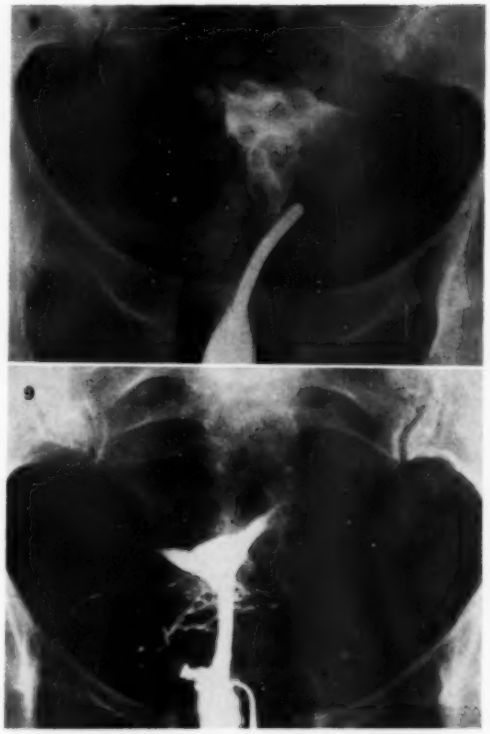

Fig. 8. Numerous small, smooth filling defects are seen throughout the entire uterine cavity. There is slight irregularity of the walls.
Impression: Multiple endometrial polyps with endometrial hyperplasia.
Fig. 9. There is a large network of contrast material adjacent to the lateral walls of the uterine cavity. The opaque material is also seen within large pelvic vessels.
Impression: Intramuscular and intravascular extravasation of contrast medium.

DIFFERENTIAL DIAGNOSIS

Endometrial Hyperplasia (Fig. 8): The roentgen findings in endometrial hyperplasia vary from an indistinctness of the walls of the uterine cavity to numerous smooth or somewhat irregular filling defects, representing polyps. On occasion, the endometrial hyperplasia may be so prominent (so-called Swiss-cheese endometrium) that incomplete filling of the lateral margins of the uterine cavity occurs, producing irregular streaks of radiopaque material adjacent to the apparent borders of the uterine cavity. These streaks do not connect with the border of the uterine cavity, and the discrete tubular appearance noted in adenomyosis is absent. They are often parallel to the walls of the uterus and rarely perpendicular, as in adenomyosis.

Penetration of Contrast Medium into the Uterine Musculature or Vascular Channels (Fig. 9): Entrance of the radiopaque ma-

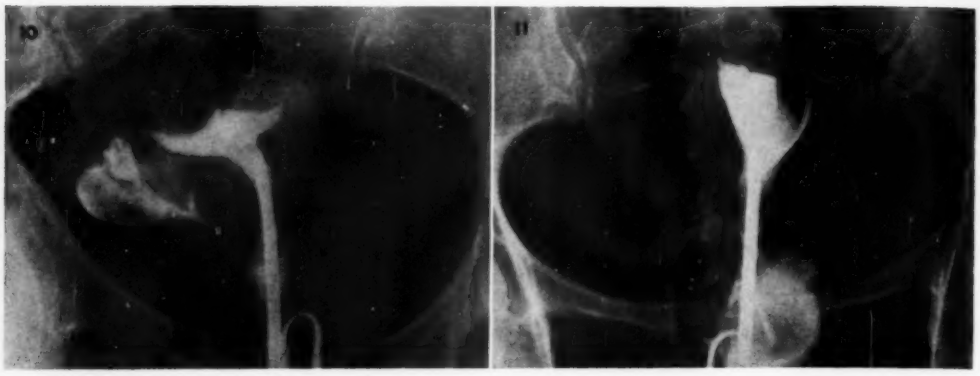

Fig. 10. The uterine cavity is moderately deformed, with two small scalloped defects on the superior surface, such as are usually seen with intramural fibroids. Several small projections are noted extending from the superior wall. Impression: Adenomyosis and intramural fibroids.

Fig. 11. The uterine cavity is normal in size, shape, and position. A smooth filling defect, 3 cm. in diameter, is noted in the left cornual region. Impression: Submucous fibroid. Operative findings: Adenomyosis.

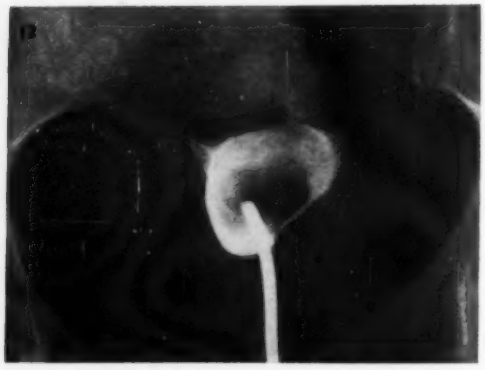

Fig. 12. The uterine cavity is moderately enlarged and globular in outline, with a large space-occupying filling defect. Impression: Submucous fibroid. Operative findings: Submucous fibroid.

terial into the uterine musculature is usually associated with obstruction of both tubes. On occasion it is seen without tubal obstruction. A small collection of contrast substance above the superior border of the uterine cavity is the most common finding associated with this condition. It can, however, occur in any portion of the uterine musculature. The vascular network is easily recognized when the vessels or sinuses are filled with a radiopaque medium.

Submucous Fibroids (Figs. 10 and 12): As stated previously, the thickened walls of the uterus in adenomyosis may produce smooth filling defects suggestive of submucous fibroid (Fig. 11). The differential diagnosis in these cases may be extremely difficult unless the spicules are seen extending from the uterine cavity. We have seen 4 cases where differentiation was impossible and a diagnosis of submucous fibroid was made.

CONCLUSION

The roentgen diagnosis of adenomyosis was established by hysterography in 38 of 150 cases of proved adenomyosis. The most typical finding was the presence of short, tubular-like structures extending perpendicularly from the borders of the uterine cavity, varying in length from 1 to 4 mm. This was more often noted with water-soluble media than with oily preparations.

Acknowledgment: Appreciation is extended to the C. V. Mosby Company for permission to reprint Figures 3 and 9.

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REFERENCES

1. BRINES, O. A., AND BLAIN, J. H.: Adenomyosis of the Uterus. Surg., Gynec. & Obst. **76**: 197–203, February 1943.

2. CULLEN, T. S.: Adenomyoma of the Uterus. Philadelphia, W. B. Saunders Co., 1908.

3. DREYFUSS, M. L.: Pathologic and Clinical Aspects of Adenomyosis and Endometriosis. Survey of 224 Cases. Am. J. Obst. & Gynec. **39**: 95–99, January 1940.

4. GOLDBERGER, M. A., MARSHAK, R. H., AND HERMEL, M.: Roentgen Diagnosis of Adenomyosis

Uteri. Am. J. Obst. & Gynec. **57**: 563–568, March 1949.
5. MEYER, R.: In HENKE-LUBARSCH: Handbuch der speziellen pathologischen Anatomie und Histologie Berlin, Julius Springer, 1930, VIII/1, pp. 249–276.
6. NOVAK, E.: Gynecological and Obstetrical Pathology. With Clinical & Endocrine Relations. 2d. ed. Philadelphia, W. B. Saunders Co., 1947.
7. v. RECKLINGHAUSEN, E.: Die Adenomyome und Cystadenome der Uterus und Tubenwandung. Berlin, A. Hirschwald, 1896.
8. v. ROKITANSKY, C.: Uber Uterusdrüsen-Neubildung. Ztschr. Gesellsch. Ärzte zu Wien **16**: 577–581, 1860.

SUMARIO

Los Hallazgos Roentgenológicos en la Adenomiosis

En 38 de 150 casos comprobados de adenomiosis, se estableció con la histerografía el diagnóstico roentgenológico de adenomiosis. El hallazgo más típico fué la presencia de tejidos tubulares cortos que se extendían perpendicularmente desde los bordes de la cavidad uterina. Esto se notó más a menudo con medios hidrosolubles de contraste que con preparaciones oleosas.

Analysis of a Method of Phlebography of the Lower Extremity in the Semi-Erect Position

DAVITT A. FELDER, M.D.

FOR THE PAST five years we have been interested in the development of a satisfactory and practical method of phlebography of the lower extremities. Our first endeavors were directed toward the study of the anatomical-spatial relationships of the deep veins (1). This formed a basis upon which future studies could be interpreted.

After the trial of various methods presented in the literature, it was thought that the most physiological approach would be one in which the flow of the contrast material in the deep veins would be in the same direction as that of the blood. Our first method using this "homorrhoeic" (ὁμος, same; ῥέω, flow) or "iso-flow"[2] technic was presented in 1950 (2). The patient was placed on the Bucky table at 15 degrees from the horizontal to give some effect of gravity and to avoid the complications of possible syncope. Table I is a résumé of the results of that method in terms of percentage of visualization.

TABLE I: VISUALIZATION PERCENTAGES WITH THE ISOFLOW TECHNIC WITH PATIENT AT 15 DEGREES FROM THE HORIZONTAL (2)

Veins Visualized	Number	Per Cent
Femoral	51	80.9
Deep femoral	10	15.0
Popliteal	54	83.0
Posterior tibials	49	75.3
Anterior tibials	10	15.0
Peroneals	60	92.3
Sural	4	6.0

In an attempt to increase the percentage of visualization and to simulate more closely the conditions existing when the patient stands, we modified this procedure in 1950, obtaining phlebograms in the semi-erect position, at 65 degrees from the horizontal. While we were still working on this method, Scott and Roach (3) described their technic of phlebography in the erect position (75 degrees from horizontal), in 1951. They showed some very fine phlebograms and recommended the method as a practical one but they did not report visualization percentages.

METHOD

With gum-rubber tourniquets applied snugly about both ankles, an infusion of 250 c.c. of normal saline was begun through No. 20-gauge needles into veins on the dorsum of both feet, except where the use of one or the other foot was contraindicated. A number of bath towels were placed under the patient's heels so that the foreportion of the feet would remain free. The x-ray table was then raised to a 65-degree angle from the horizontal. Both needles and adapters were connected by their tubing, through a glass Y-tube, to a single rubber tubing applied to the adapter of a regular intravenous set. For injection of the contrast medium, this latter tube was disconnected from the intravenous adapter and a syringe containing the contrast medium was inserted. The intravenous set was shut off temporarily. Injection of 40 c.c. Diodrast[3] 35 per cent was then made at the rate of about 1 c.c. per second. At the end of the injection the syringe was replaced by the intravenous set adapter and the saline again run in at a rate of 30 to 40 drops per minute. The intravenous solution reservoir was elevated well above the level of the patient's heart to provide adequate gravitational force for infusion.

A first exposure of the legs was made at

[1] From the Departments of Surgery and Radiology, University of Minnesota Medical School, Minneapolis 14, Minn. Accepted for publication in May 1954.

[2] A term coined by my colleague, Dr. Thomas O. Murphy. This term conveys the idea, although it is admittedly an accepted perversion of the prefix "iso" and a mixture of terms of Greek and English origin.

[3] Winthrop-Stearns, Inc.

two minutes after the injection was begun,[4] and a second exposure as soon after this as possible, in a lateral stereo position with a tube shift of 3.5 cm. The tube and cassette carrier were then shifted to the thigh region, and a film of the thigh was obtained at two and a half to three minutes. A fourth exposure was made of the legs at three minutes, another of the thighs at four minutes, and still another of the leg at five minutes. Some studies were made at odd times because of difficulties with equipment or inexperience of new personnel. In six instances films of the leg were made at six minutes.

In all of the patients studied, a 0.25 to 0.5 c.c. test dose of Diodrast 35 per cent was injected into the intravenous tubing prior to phlebography. No patients were studied who had any previous history of asthma, hay fever, or iodine or other sensitivity except food idiosyncrasies.

In 10 studies a pneumatic cuff was placed around the ankle as a tourniquet. During the injection of the contrast medium and continuously throughout each study the pressure in the cuff was maintained. Pressures of 20, 40, 80, 100, and 110 mm. of mercury were used for two studies each.

RESULTS

Fifty-three phlebographic studies of the lower extremity were made by this method in 28 patients. The average age of these patients was fifty years. Twenty-three were females and 5 males.

Clinical Grouping and Phlebographic Correlation: Three different clinical groups of extremities were studied: (A) those with no history or evidence of venous disease; (B) those with superficial varices without a history of previous deep-vein thrombosis; (C) those with a history of deep-vein thrombosis as well as evidence of venous disease, such as persistent edema, stasis changes in the skin, or even ulceration. The correlation of the clinical evaluation with the phlebographic result is given in Table II.

[4] The first three subjects were studied fluoroscopically and it was found that the contrast medium was at the popliteal level at one and a half to two minutes.

TABLE II: CORRELATION OF CLINICAL GROUPING WITH PHLEBOGRAPHIC FINDINGS
(Isoflow Method with Patient at 65 Degrees from the Horizontal)

Clinical Grouping	Phlebographic Findings	Number of Cases
Group A: No evidence of venous disease (10 cases)	Normal deep veins	7
	Unsatisfactory	3
Group B: Superficial varices; no evidence of deep venous abnormality (23 cases)	Normal deep veins	15
	Incompetent deep veins	5
	Old deep-vein thrombosis	3
Group C: Post-thrombosis syndrome (20 cases)	Old deep-vein thrombosis	17
	Incompetent deep veins	1
	Unsatisfactory	2

Group A: Ten phlebographic studies were made of extremities with no history or evidence of venous disease. Seven were interpreted as indicating normal deep veins and, when these were seen, normal superficial veins. Three studies were unsatisfactory for detailed study of valves and were repeated. These are included among those showing normal veins.

Group B: There were 23 phlebographic studies made of extremities with superficial varices but no history of deep-vein thrombosis. Normal appearing deep veins were visualized in 15 of these studies. The picture of deep-vein incompetence with varicosis or simple dilatation, described by this author in 1953 (4), and valvular incompetence according to the criteria of Sgalitzer *et al.* (5) was seen in 5 of this group. In 3 studies the appearance of an old deep-vein thrombosis, as described by Lesser and Danelius, was found (6).

Group C: Twenty phlebographic studies were made of extremities with clinical evidence of venous disease. The picture of old deep-vein thrombosis was seen in 17. Two studies were unsatisfactory for detailed study of valves. On repetition, both of these showed the characteristics of old deep-vein thrombosis and they are included in that number. One study showed only the characteristics of a deep-vein incompetence.

TABLE III: PHLEBOGRAPHIC UNITS OF VISUALIZATION FOR VEINS OF THE LOWER EXTREMITY RELATED TO TIME AFTER INJECTION OF THE CONTRAST MEDIUM AND TO CLINICAL GROUPING

	Exposures 1 and 2 (Stereo)									Exposure 4									Exposure 6					
Time (minutes)	1½			2			2½			3			3½			4			5			6		
Group*	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Number of Studies	1	3	2	9	20	18	0	1	1	5	1	3	0	1	1	4	15	9	1	2	3	1	6	1
Leg																								
Anterior tibial	1	0	1	3	5	7		0	0	2	0	0		0	0	2	2	3	0	0	0	0	0	0
Peroneal	1	3	2	8	19	15		1	1	3	1	2		1	1	4	13	7	0	2	1	0	4	1
Posterior tibial	0	3	2	8	19	16		1	1	3	1	2		1	1	3	12	6	1	2	2	0	3	1
Sural	0	0	0	6	2	6		0	0	3	0	1		1	0	3	3	3	1	0	2	0	1	0
Popliteal	1	0	1	9	15	16		1	1	3	1	3		1	1	4	14	5	1	0	2	0	4	1
	Exposure 3															Exposure 5								
Number of Studies	0	0	0	0	3	1	2	0	1	7	17	15	3	2	1	3	4	4	3	8	6	0	2	1
Thigh																								
Popliteal					3	1	2		1	5	12	9	2	0	0	2	1	3	1	5	3		0	0
Femoral					3	1	2		1	5	13	10	2	0	0	2	1	3	1	6	1		0	0
Deep femoral					0	0	0		1	4	1	1	0	0	0	2	0	0	0	0	0		0	0

* A. Lower extremities without history or evidence of venous disease. B. Lower extremities with superficial varices but without a history of deep-vein thrombosis. C. Lower extremities with history and evidence of deep-vein disease.

Visualization in Relation to Time after Injection: According to the original plan, the first two films of the leg were taken at two minutes and two minutes and fifteen seconds after the beginning of the injection of the contrast medium. Since these were stereoscopic films and since their exposure was so close in point of time, they will be considered together as the first film. In Table III can be seen the number of studies done in each group for each time of exposure and the visualization number for each vein or group of veins. The columns set off by heavy rules in the table, namely, at two and four minutes for the leg film and at three and five minutes for thigh films, with a few exceptions represent consecutive studies in the same individuals. As can be seen by this table, several studies were done, with the time of exposure varied for both the thigh and leg films.

A comparison of all clinical groups (A, B, C) in the two- and four-minute periods shows an overall decrease in the number of veins seen at the latter time. This was also true of the three- and five-minute thigh films for all groups. When one compares the number of veins visualized in the thigh in relation to the number of studies that were done, it is apparent that far fewer veins were visualized in the thigh per a given number of studies than in the leg.

More sural, or calf, veins per number of studies were seen in the initial exposures in Group A than in the other two groups. It should be noted that sural veins not visualized in the initial exposures were often demonstrable later.

Percentage of Visualization: After examining each study for all of the different time exposures, we were able to tabulate the number of times that each vein or group of veins was seen. If the vein or veins in question were seen throughout the study on one or more of the exposures, this was considered as one unit of visualization. A separate study of this type was made for the thigh. Each clinical group was studied separately, and the results of these studies are presented in Table IV. The overall visualization shows that the peroneal, posterior tibial, and popliteal veins in the leg have a fairly high visualization percentage, whereas the anterior tibial and sural veins do not. In the thigh, the popliteal and femoral veins have a 68 and 70 visualization percentage, respectively, whereas the percentage for the deep femoral vein is much lower.

Unsatisfactory Phlebograms: Four phlebographic studies of the leg were unsatis-

TABLE IV: VISUALIZATION PERCENTAGES FOR VEINS OF THE LOWER EXTREMITY
(Iso-flow phlebography in the semi-erect position)

Group*	A	B	C	All Groups
Number of Studies	10	23	20	53
	Number	Number	Number	Number
Leg				
Anterior tibial	4 (40%)	5 (22%)	7 (35%)	16 (30%)
Peroneal	9 (90%)	22 (95%)	17 (74%)	48 (91%)
Posterior tibial	8 (80%)	22 (95%)	18 (78%)	48 (91%)
Sural	7 (70%)	4 (17%)	6 (30%)	17 (32%)
Popliteal	10 (100%)	15 (65%)	18 (78%)	43 (81%)
Number of Studies	10	22	18	50
Thigh				
Popliteal	7 (70%)	15 (68%)	12 (62%)	34 (68%)
Femoral	7 (70%)	16 (73%)	12 (62%)	35 (70%)
Deep femoral	4 (40%)	1 (4.5%)	2 (11%)	7 (14%)

* A. Lower extremities without history or evidence of venous disease. B. Lower extremities with superficial varices but without a history of deep-vein thrombosis. C. Lower extremities with history and evidence of deep-vein disease.

factory. Of these 3 were repeated. Films with poor detail were considered satisfactory, however, from the standpoint of visualization for time calculations. In some of these, careful study of the valve leaflets and other minor details was not possible. There was only one thigh film in the entire series that was completely unsatisfactory. In 12 instances the contrast material could be made out passing under the gum-rubber tourniquets in the superficial veins.

Reactions: No generalized reactions or attacks of syncope occurred in this series. Four patients complained of nausea; none experienced vomiting or retching and none displayed any dermatological signs or symptoms. A few patients complained of a sensation of tightness in the feet. All experienced a generalized flush upon release of the tourniquets from the ankles and return of the table to the horizontal position. There was no extravasation of contrast medium in the series. A single instance of superficial thrombophlebitis occurred, with onset one week after the study.

Pneumatic Cuff Studies: In all 10 pneumatic cuff studies, with pressures at 20, 40, 80, 100, and 110 mm. of mercury, the contrast medium was seen passing under the cuff in the superficial veins as well as the deep veins.

DISCUSSION

The practical value of this, as of other radiological procedures, is determined by the visualization percentage, which should therefore be the first consideration. It can be seen from Table IV that the visualization falls short of the ideal.

In comparison with the results of our earlier method (2), summarized in Table I, in which the patient was at 15 degrees from the horizontal, the posterior tibial, peroneal, and popliteal veins show no significant change in visualization percentage. The anterior tibial and sural veins were visualized twice as often as with the earlier method, yet still in only 30 per cent of the studies.

The low visualization percentage of the sural veins may well be related to the fact that they are not often connected by direct tributaries with the veins of the foot in which the contrast medium is injected. Deep vein thrombosis, however, is frequently suspected of having its origin or site in the sural veins, as brought out by Hunter *et al.* (7). The fact that the poorest visualization percentages for these veins were in Group C may be related to previous thrombosis in some instances.

The reason for the low percentage of visualization of the anterior tibial veins may be related to their superficial position

at the ankle in some individuals, where they may be subject to compression by the tourniquet.

The popliteal vein was seen in either the leg or thigh exposures in practically 100 per cent of the studies. For the femoral vein, on the other hand, the visualization percentage is only 70 as compared to 80.9 with the previously reported method (2).

The contrast medium was still seen in the leg veins as late as four minutes after injection. The initial contrast medium which visualized the popliteal vein disappeared early, or at least was not seen to progress into the femoral vein. In these instances the popliteal vein in the first exposures probably represented the head of the column of contrast medium which later diffused into the femoral vein. As brought out by Scott and Roach (3), the venous reservoir of the leg in the upright position is probably much larger than in the 15-degree position. There was probably not enough medium available for visualization of the femoral veins. We are at present evaluating the use of more contrast material in a current series of phlebograms.[5]

The limited observations with the pneumatic cuff indicate a much greater intravenous pressure produced by the administering syringe than was expected. In order to be effective, a pressure in the cuff bladder above 110 mm. of mercury would have to obtain.

SUMMARY AND CONCLUSIONS

The analysis of a method of phlebography, using stereoroentgenograms with the subject at 65 degrees from the horizontal, has been presented. Fifty-three studies in 28 patients were made by this method. The extremities were divided into three groups: those considered normal, those with superficial varices only, and those with clinical deep-vein disease. Multiple exposures were made at varying times between one and a half and six minutes after injection was begun, for both the legs and the thigh, with a minimum of five exposures for each study. An analysis of the visualization percentages in relation to the time after injection was made for all of the deep veins of the leg and thigh.

These studies would indicate that phlebography in the upright position, by the "isoflow" technic, has a practical application. Such studies can be expected to visualize the major deep veins of the leg, with the exception of the anterior tibial and sural veins, in at least 90 per cent of the examinations, both in normal persons and in those with chronic deep vein difficulties. The sural or calf veins can be expected to be visualized best in the late exposures. The popliteal vein and the lower femoral vein should be demonstrable approximately 100 per cent of the time in normals and in patients with chronic or old deep vein disability. The deep femoral vein of the thigh is not satisfactorily visualized by the method presented here.

These studies show that the optimum time for exposure of the leg is at two minutes after the beginning of injection of the contrast material. The optimum exposure for thigh films is between two and two and a half minutes after the injection is begun. We believe that further studies are indicated, using more contrast medium and possibly other variations of technic, to produce visualization of the deep veins in a higher percentage of cases.

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[5] Since this paper was submitted for publication, we have published the results of work (then "current") using more contrast material. This resulted in a much higher percentage of visualization for the anterior tibial, deep femoral, and sural veins. See FELDER, D. A., and MURPHY T. O.: Evaluation of a Method of Phlebography of the Lower Extremities. Surgery **37**: 198–205, 1955.

REFERENCES

1. FELDER, D. A.: Anatomical-Spatial Relationships of the Deep Veins of the Lower Extremity as a Basis for Venographic Interpretation. Radiology **54**: 521–526, April 1950.

2. FELDER, D. A.: A Method of Venography. Radiology **54**: 516–520, April 1950.

3. SCOTT, H. W., JR., AND ROACH, J. F.: Phlebography of the Leg in the Erect Position. Ann. Surg. **134**: 104–109, July 1951.

4. FELDER, D. A.: The Phlebographic Diagnosis and Treatment of the Post-Phlebitic Syndrome. Radiology **61**: 208–214, August 1953.
5. SGALITZER, M., KOLLERT, V., AND DEMEL, R.: Kontrastdarstellung der Venen im Röntgenbilde. Klin. Wchnschr. **10**: 1659–1663, Sept. 5, 1931.
6. LESSER, A., AND DANELIUS, G.: Venography: Its Value in the Diagnosis and Management of Venous Disturbances of the Lower Extremities. Ann. Surg. **119**: 903–921, June 1944.
7. HUNTER, W. C., KRYGIER, J. J., KENNEDY, J. C., AND SNEEDEN, V. D.: Etiology and Prevention of Thrombosis of the Deep Leg Veins. Study of 400 Cases. Surgery **17**: 178–190, February 1945.

SUMARIO

Análisis de un Método para la Flebografía del Miembro Inferior en Posición Semierecta

Preséntase el análisis de un método flebográfico que utiliza estereorroentgenogramas, con el sujeto a 65 grados de la horizontal. Con este método, se ejecutaron cincuenta y tres estudios en 28 enfermos. Los miembros fueron divididos en tres grupos: los considerados normales, los que no tenían más que várices superficiales y los que tenían enfermedad clínica de las venas profunda. Se hicieron muchas exposiciones en varias ocasiones de uno y medio a seis minutos después de iniciar la inyección, tanto de las piernas como del muslo, con un mínimo de cinco exposiciones para cada estudio. Se hizo un análisis de los porcentajes de visualización en relación cronológica a la inyección para todas las venas profundas de la pierna y del muslo.

Indican estos estudios que la flebografía en la posición vertical, con la técnica del "isoflujo" (es decir, el flujo de la substancia de contraste en la misma dirección que el de la sangre) tiene aplicación práctica. Cabe esperar que esos estudios visualicen las principales venas de la pierna, con excepción de las tibiales anteriores y las surales a lo menos en 90 por ciento de los exámenes, tanto en los sujetos normales como en los que tienen trastornos crónicos de las venas profundas. Es de esperar que se visualicen mejor las venas surales (o de la pantorrilla) en las últimas exposiciones. La poplítea y la femoral inferior deben observarse aproximadamente 100 por ciento de las veces en los sujetos normales y en los que padecen de incapacidad crónica o antigua de las venas profundas. No se visualiza satisfactoriamente la vena femoral profunda del muslo.

Demuestran estos estudios que el momento óptimo para las exposiciones de la pierna es a los dos minutos de comenzar la inyección de la substancia de contraste. La exposición óptima para las radiografías del muslo es de dos a dos y medio minutos después de iniciar la inyección. Hállanse indicados estudios ulteriores, con el uso de más medio de contraste y posiblemente otras variaciones de la técnica, para producir un porcentaje mayor de visualización de las venas profundas.

The Treatment of Thyrotoxicosis with Radioiodine[1]

KENT F. BALLS, M.D., RICHARD H. CHAMBERLAIN, M.D., EDWARD ROSE, M.D., ROBERT O. GORSON, M.S., and HENRY C. BLOUNT, JR., M.D.

ALTHOUGH THE literature now contains many reports dealing with various aspects of the treatment of thyrotoxicosis with radioiodine, the persistence of several important unsolved problems seems to justify the presentation of additional experience acquired with statistically significant groups of cases. It is our purpose here to report such a group of patients. Although our experience to date has comprised more than 400 cases, we have included in this report only 180 of the first 228 patients treated by us.

MATERIAL

During the period from November 1947 to December 1952, 228 patients were treated for thyrotoxicosis with radioiodine 131.[2] From these we selected 180 who have been followed for one year or more after treatment, and in whom the diagnosis was established beyond reasonable doubt on the basis of the clinical picture and standard diagnostic procedures. This group consisted of 37 males and 143 females, a ratio of approximately 1 to 4. The age range for men was from twenty-two to seventy-two years and for women from twenty to seventy-three.

In patients below the age of forty, we have not considered I^{131} the treatment of choice unless previous thyroidectomy or other unusual circumstances dictated otherwise. In Figure 1 is shown the age distribution by decades, the largest group of 53 patients (29.4 per cent) being in the sixth decade. The general age incidence of thyrotoxicosis is also shown for the sake of comparison.

In addition to 42 patients with postoperative recurrence there were 138 previously untreated or who had received antithyroid medication without permanent remission. Fifteen of the latter were classified as having toxic nodular goiters and the other 123 as having toxic diffuse goiters.

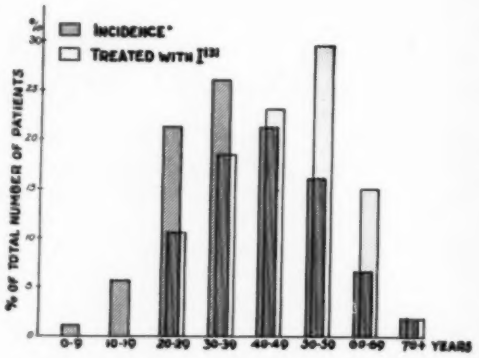

Fig. 1. Age distribution: cases treated with I^{131} *vs.* incidence of thyrotoxicosis. (Figures quoted from Williams' *Textbook of Endocrinology.*)

RESULTS

The results of therapy with radioiodine in the entire group are shown in Figure 2. Almost 80 per cent of the patients were relieved of their thyrotoxic symptoms following an initial dose of I^{131}, and in more than 97 per cent thyrotoxicosis disappeared after one or more treatments. When last evaluated, 142 patients (78.9 per cent) were euthyroid, 33 (18.3 per cent) were hypothyroid, and 5 (2.8 per cent) were considered as having shown unsatisfactory responses to I^{131}. The unsatisfactory group included 4 women with large goiters, who subsequently underwent thyroidectomy, and 1 who died in thyroid storm. These cases are briefly summarized below.

CASE I: J. G., a 24-year-old Negro female with a large toxic diffuse goiter, had received two prolonged courses of thiouracil compounds. She relapsed into

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[1] From the Department of Radiology and the Endocrine Section of the Medical Clinic, Hospital of the University of Pennsylvania. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

[2] Obtained from U. S. Atomic Energy Commission, Oak Ridge National Laboratories.

her former thyrotoxic state following withdrawal of medication. Four months later she received 7 millicuries of I^{131}, with subsequent gradual partial improvement. Her basal metabolism rate declined from +41 to +28 per cent two months after treatment. A second dose of I^{131} was refused, and thyroidectomy was later performed, followed by a satisfactory remission.

CASE II: G. T., a 53-year-old white female with a diffuse goiter estimated to weigh about 100 gm., had persistent thyrotoxicosis despite four months of propylthiouracil and stable iodine administration. Four months after withdrawal of this medication she received 4 millicuries of I^{131}, with 58 per cent thyroid uptake of the isotope in twenty-four hours. Two months later her basal metabolism rate was still elevated (+47 per cent). After suitable preparation she underwent a subtotal thyroidectomy, which was followed by a satisfactory remission.

CASE III: R. S., a 42-year-old white female with a large toxic diffuse goiter of about 400 gm., was controlled with antithyroid medication during pregnancy and a normal delivery. When she failed to enter a remission after delivery, thyroidectomy was advised but refused. She was not seen again for seven years, during which time she was without antithyroid therapy. When she returned, her thyrotoxicosis was still severe, with a basal metabolism rate of +42 per cent. She then received 7 millicuries of I^{131} in an attempt to reduce her toxicity stepwise. Three months later there had been no apparent change in the size of the goiter or degree of thyrotoxicosis. At this point the patient agreed to undergo thyroidectomy and was prepared preoperatively with Methimazole. After subtotal thyroidectomy she remained euthyroid.

CASE IV: C. R., a 60-year-old white female with a large toxic diffuse goiter, diabetes, hypertension, and cardiovascular disease, received propylthiouracil for one year, with satisfactory response. One month after withdrawal of the drug she seemed to have relapsed and was given 9 millicuries of I^{131}, with an uptake of only 10 per cent at forty-eight hours. Three days after receiving I^{131}, she went into severe cardiac failure with auricular fibrillation. Propylthiouracil was started again during this presumed exacerbation of thyrotoxicosis, and seven months later an uneventful thyroidectomy was performed. The patient has remained in remission since the operation.

CASE V: M. R., a 28-year-old white female, had a large diffuse goiter estimated to weigh over 400 gm. She had been severely thyrotoxic for several years and treatment had been hampered by her lack of cooperation. Two attempts had been made to prepare her for thyroidectomy. Once she had refused operation when her condition was considered suitable; the second attempt had failed to induce a satisfactory preoperative remission. When first seen by us, while still on propylthiouracil and stable iodine, she was severely toxic, with a basal metabolism rate of +108 per cent. The problem seemed urgent and, without prior withdrawal of propylthiouracil and iodine, 10 millicuries of I^{131} was given, after which the antithyroid medication was discontinued. The patient was discharged with instructions to remain under the close supervision of her family physician and to return for examination in one month. She failed to cooperate, however, and was not seen until one month later, when she was readmitted in thyroid storm accompanied by psychosis. Treatment was without avail, and three days after admission she died.

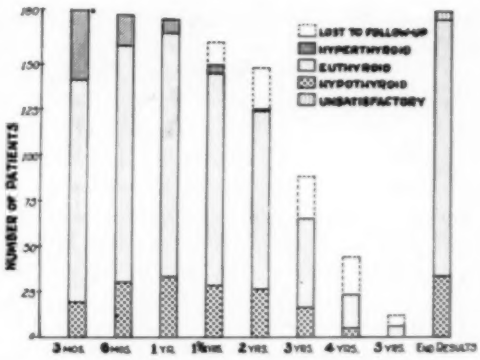

Fig. 2. Results of treatment of thyrotoxicosis with I^{131}. Analysis at intervals after initial treatment compared to end-result (or when lost to follow-up).

In Cases I–IV further treatment with I^{131} might well have rendered the patients euthyroid. However, patient J. G. (Case I) refused a second treatment, and in Cases II and III a more rapidly effective method of controlling the thyrotoxicosis was considered desirable. Both of these patients were treated in early years, when our experience with radioiodine was still relatively limited. Patient C. R. (Case IV), with an I^{131} uptake of only 10 per cent at forty-eight hours, received insufficient irradiation for a therapeutic effect, although a temporary exacerbation of toxicity seemed related to the treatment. The fifth patient (M. R.) was in an extremely toxic state at the time of treatment, and either an adverse reaction to the I^{131} or to the withdrawal of other antithyroid compounds allowed the full blown picture of thyroid crisis to develop. This is the only instance in our experience in

which death could be attributed to the use of radioactive iodine.[3]

The effectiveness of radioiodine in relieving the thyrotoxicosis associated with various types of goiter is shown in Figure 3. Very little difference in response to treatment was observed between diffuse goiters, postoperative recurrent goiters, and nodular goiters, although the group of nodular goiters was small. When response to I^{131} is analyzed with respect to the initial size of the goiter (Fig. 3), it is apparent that patients without palpable goiters, or with goiters of less than 80 gm. estimated weight, responded better than those with large goiters (estimated weight greater than 80 gm.). The latter group of 19 patients contained all 5 of our unsatisfactory therapeutic responses.

In most of the patients with enlarged thyroids (158 patients had palpable goiters initially), a reduction in goiter size was observed to occur simultaneously with improvement in the signs and symptoms of thyrotoxicosis. Twenty goiters did not decrease in size after the first dose of I^{131}, but with repeated treatment 10 of these became smaller. Among the 10 remaining patients (6.3 per cent) there were 3 with nodular goiters and 2 with diffusely enlarged glands which remained unchanged despite relief of the hyperthyroidism. The other 5 patients were the ones discussed previously as showing unsatisfactory responses.

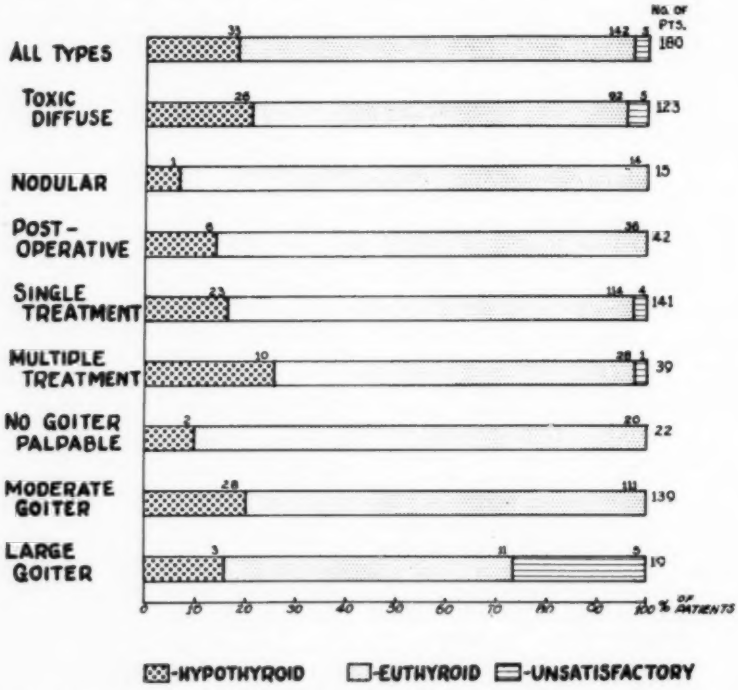

Fig. 3. End-results of treatment with I^{131} related to clinical type of thyrotoxicosis and number of treatments with I^{131}.

DOSAGE

Despite various efforts to devise a useful formula for predetermining the number of millicuries of I^{131} to be administered, we do not think that a satisfactory method has been found. Our selection of the

[3] Two other patients who died of causes not related to thyrotoxicosis or radioiodine were omitted from our series of 180 cases. Death was due to occlusion of the abdominal aorta six months after I^{131} in one and to diabetic gangrene five months after treatment in the other.

TABLE I: RESULTS OF I^{131} THERAPY (INITIAL SINGLE DOSE) IN RELATION TO CALCULATED RADIATION DOSE (IN RADS)

	Dose in Rads (Beta)				
	0–5,000	5,000–10,000	10,000–15,000	15,000–20,000+	Total
Hyperthyroid	12 (46%)	21 (23%)	8 (19%)	2 (12%)	43
Euthyroid	11 (42%)	62 (67%)	24 (59%)	13 (76%)	110
Hypothyroid	3 (12%)	9 (10%)	9 (22%)	2 (12%)	23
TOTAL	26	92	41	17	176

exact amount of I^{131} to be administered to the thyrotoxic patient still depends chiefly on clinical judgment. The initial dose was usually not less than 6 millicuries or more than 10 millicuries of I^{131}. The smaller doses were given to patients with small glands and high thyroid tracer uptakes, and the larger doses to patients with large glands and lower thyroid tracer uptakes. Thirty-nine of the 180 patients (21.6 per cent) received two or more treatment doses of I^{131}; 7 of these received a third dose; and 1 had a total of four doses. The average initial dose was 7.5 millicuries and the second and third doses averaged 6.5 and 6.6 millicuries, respectively.

The average radiation dosage (in rads) was calculated for 176 patients, and is shown roughly in Table I. Because this table seems to show a higher degree of correlation between rad dosage and result than actually existed, the data are presented in more detailed form in Figure 4. This reveals more clearly the considerable variation in response that was observed within each dosage range.

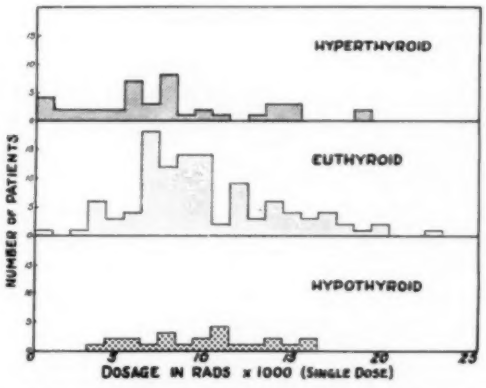

Fig. 4. Distribution of results of initial treatment (single dose of I^{131}) in 176 patients, related to calculated radiation dose.

INSTRUMENTATION AND DOSIMETRY

All of the I^{131} used for the patients in this study was obtained from Oak Ridge National Laboratories in the form of carrier-free NaI in basic Na_2SO_3 solution. It was assayed and standardized in our own laboratory and administered orally to all patients. The uptake measurements in the thyroid and adjacent tissues for both tracer doses and treatment doses were made at approximately twenty-four hours and forty-eight hours after administration The calculations are in terms of the per cent of the amount given without correction for physical decay. The values therefore are expressed as effective uptakes, which may be converted to biological uptakes by multiplying the twenty-four-hour figure by 1.09 and the forty-eight-hour figure by 1.16. The tracer uptakes at twenty-four hours which were below 45 per cent were considered to be within the euthyroid range. Twenty-four-hour figures exceeding 50 per cent were considered compatible with hyperthyroidism.

The millicurie values are all expressed in terms of the National Bureau of Standards millicurie of I^{131}. Doses given to patients prior to the National Bureau of Standards series of intercomparison tests in 1949 have been corrected to that value.

The technic of counting over the thyroid has been altered from time to time with different arrangements of Geiger tubes and counting apparatus. All of these technics were intercompared at the time the changes were made, and the uptake measurements have been normalized to the point where the figures should be relatively independent of the system used. The optimal arrangement so far achieved employs a stainless steel Geiger tube for

tracer measurements and a halogen quenching gas tube for the counting of patients who have received treatment doses. These shielded tubes are arranged in adjacent collimators at a distance of 30 cm. from the suprasternal notch to the center of the Geiger tubes. Lead filters of $^1/_{64}$ inch thickness for the stainless steel tube and $^1/_{16}$ inch thickness for the halogen gas tube are employed. The collimators are so designed that both Geiger tubes subtend approximately the same solid angle at the thyroid. The calibration of the counter systems has been made with I^{131} standards and with phantoms. These phantoms as presently designed seem to give a good approximation of the conditions encountered with the thyroid gland in the neck in so far as radiation absorption and scatter phenomena are concerned.

For purposes of calculating average beta dose, the following formula was used:

$$D_\beta = 73.8\, \bar{E} T C_0 \quad \text{rads}$$

where $\bar{E}$ is the effective average beta particle energy in mev; T is the effective half-life, in days, of the isotope in the tissue of interest; C_0 is the initial average concentration in microcuries per gram.

Estimates of the size of the thyroid gland were obtained from data supplied independently by two or more physicians. The twenty-four-hour uptake figure was used as the basis for determining the initial concentration. The average beta particle energy for I^{131} was assumed to be 0.2 mev. Considerable difficulty was encountered in estimating accurately the effective half-life in many cases. An assumed half-life value of six days was used in the absence of more extensive data. It is our feeling that the uncertainty in the estimation of the effective half-life would not introduce errors exceeding 30 per cent and would not invalidate the general conclusions drawn from the calculated beta dose. Calculations of the dose from the gamma ray component of I^{131} radiations were omitted, as this was relatively insignificant.

REACTIONS

Untoward reactions to treatment were infrequent and usually mild in this series. Fourteen patients (9 per cent) complained of moderate to severe sore throat one to two weeks after treatment. General reactions consisting of exacerbation of thyrotoxicosis or precipitation of cardiac complaints have been less common but were serious when they occurred. Five patients (2.8 per cent) showed such general reactions. Included in this small group was the extremely thyrotoxic patient (Case V) whose disease became more severe two weeks after treatment and culminated in fatal thyroid storm one month after she was given 10 millicuries of I^{131}. Another patient exhibited nervousness, mental confusion, fever, and auricular fibrillation during the second week. In 2 others with arteriosclerotic heart disease and 1 with rheumatic heart disease, auricular fibrillation and cardiac failure developed. The reactions in these 3 patients occurred within three to four days after the administration of I^{131}. This time interval seems short if the reactions are to be attributed solely to the action of radioiodine in releasing thyroid hormone.

In an effort to prevent delayed reactions, interim control of hyperthyroidism with antithyroid medication (propylthiouracil or Methimazole) was maintained in 13 severely toxic patients. A period of two weeks was allowed to elapse following the therapeutic dose in the hope that interference with the effective half-life and recirculation of I^{131} would be reduced. Others (2) have suggested that such interim control may be a factor in the requirement for additional therapeutic doses of I^{131}. While our group of such cases was too small to permit conclusions, 5 of the 13 patients receiving such medication did require more than one dose of I^{131}. Even though it may interfere with full effect from I^{131}, we believe that such interim control may occasionally be advisable in patients with severe toxicity or complications such as cardiac failure or severe di-

abetes, while awaiting the ultimate effect of the radioiodine.

HYPOTHYROIDISM

Hypothyroidism has been one of our major problems, occurring in 16.3 per cent of patients receiving only one dose and in 25.6 per cent of those receiving multiple doses of I^{131}. The overall incidence for the entire series was 18.3 per cent. We have considered as hypothyroid every patient receiving thyroid replacement therapy after the first year of follow-up, without regard to severity or the possible resumption of a euthyroid state at a later date. There were 11 other patients who showed transitory hypothyroidism within the first year.

Of particular interest in connection with the problem of hypothyroidism was the occurrence of muscle cramps as a prominent and occasionally distressing symptom, which seems to have received little previous attention in the literature. This reaction was noted in 13 of the 33 patients who developed persistent hypothyroidism, and also in 3 of the 11 temporarily hypothyroid patients. These cramps were most commonly noted in the muscles of the lower thorax and posterior cervical region, occasionally in the abdomen, thighs, and distal extremities, and were usually precipitated by movement. They were invariably relieved by adequate thyroid replacement therapy. A typical example is presented below:

M. Y., a 35-year-old white female with a moderately large toxic diffuse goiter, was maintained relatively free of thyrotoxic symptoms for eighteen months on large doses of propylthiouracil. Antithyroid medication was stopped, and within the month prior to radioiodine therapy the patient again became toxic. Eight millicuries of I^{131} were administered, with a 68 per cent uptake of the treatment dose in twenty-four hours. Six weeks after treatment there was no palpable goiter and the patient felt well. This improvement continued until the fifth month, when progressive dullness, fatigue, and sensitivity to cold were noted. Painfully severe and incapacitating muscle cramps occurred in the legs and were precipitated in the cervical and thoracic muscles by twisting. The patient was admitted to the neurological service, where studies of muscle function confirmed the impression of myotonia acquisita. At this time her basal metabolism rate was −21 per cent and serum cholesterol 454 mg./100 c.c. Desiccated thyroid brought about relief of muscle cramps and return of normal muscle function, along with improvement in other symptoms of hypothyroidism. The patient has remained dependent upon thyroid replacement therapy.

EXOPHTHALMOS

Exophthalmos was present prior to treatment in 57 patients (31.6 per cent); it was considered slight to moderate in 48 and marked in 9 patients. After treatment with I^{131}, 36 patients showed some improvement in ocular signs, 18 showed no apparent change, and only 3 showed an increase in exophthalmos. We have seen no example of hyperophthalmopathic Graves' disease (progressive malignant or "thyrotropic" exophthalmos) beginning after treatment with radioactive iodine.

DISCUSSION

The principal current problem in the treatment of thyrotoxicosis with radioiodine is the selection of the dose of I^{131} which offers the maximal prospect of producing a permanent euthyroid state with minimal risk of residual permanent hypothyroidism. We have not been satisfied with mathematical solutions currently used (3, 4, 5, 6). The various formulae proposed for the selection of this dose may be unsatisfactory because of the following factors (7, 8): (*a*) inaccuracies in the estimation of the weight of the thyroid, which may easily be in error by as great a factor as 2; (*b*) uneven distribution of the radioisotope within the thyroid; (*c*) unpredictability of the sensitivity of the thyroid to the irradiation; (*d*) uncertainty that the thyroid uptake of the treatment dose will be the same as the preliminary tracer uptake; (*e*) difficulties in prior estimation of effective half-life, sometimes complicated by alterations in peripheral iodine space and renal excretion of the isotope. At present our choice of dose is based on rough estimation of the size of the gland and the clinical and tracer

evidence of the severity of the thyrotoxicosis. We feel that there is considerable merit in the recipe of Seed, as follows (9):

"A great many side factors of a practical nature will influence the choice of the initial dose, all of them quite obvious to the clinician when he is presented with a particular patient. It is wise to give the minimum effective dose in a young patient, add a few (millicuries) more if the symptoms are severe, double the dose if the heart is badly damaged, subtract a millicurie or two if the patient is already overweight, add a couple if the patient lives out of town, or if the patient's doctor is dubious of the value of the treatment."

Myxedema occurs with undesirable frequency following treatment with radioiodine. Our figures show a higher incidence than has been reported following surgical thyroidectomy, although the hypothyroidism following I^{131} may not so often be permanent. Our limited experience does not confirm previous statements that hypothyroidism occurs more frequently after a single dose than when multiple doses are required (10). We were unable to establish a significant relationship between the incidence of myxedema and the radioiodine dosage administered or the calculated radiation dosage in rads. Twenty of our 33 hypothyroid patients received total doses of less than 10 millicuries, and the largest single group of these, numbering 9, received 7 millicuries each. As pointed out by Seed and Jaffé, there seem to be variations in sensitivity to the action of radioiodine in certain thyrotoxic patients, which make the development of myxedema unpredictable. Efforts have been made to avoid myxedema by inducing a euthyroid state gradually with a series of small doses of I^{131}, given at frequent intervals (11). One disadvantage of this method lies in the prolonged time required for complete remission.

Our results seem to agree with the reported experience of others in the following: (*a*) a satisfactorily high incidence of relief of thyrotoxicosis, comparing favorably with the best results to be expected from thyroidectomy, except for the frequency of hypothyroidism (even in our 5 patients classed as therapeutically unsatisfactory it seems quite possible that ultimate success might have been attained in the 4 who survived had we persisted with further treatment); (*b*) the greater difficulty in treating thyrotoxic patients with large goiters with radioiodine; (*c*) the low incidence of severe local or general reactions to treatment; (*d*) the high incidence of success (100 per cent) in patients with postoperative recurrent thyrotoxicosis. Our results appear somewhat at variance with the reported experience of others with respect to: (*a*) an apparently high incidence of hypothyroidism (about twice that reported in the summary of the literature by Seed and Jaffé (10); (*b*) a higher incidence of remission in toxic nodular goiter than has been generally reported. It should be noted that our group of patients with toxic nodular goiters is small, since radioiodine was used in such cases only under exceptional circumstances, (refusal of surgery, etc.). We agree that the toxic nodular goiter should be treated surgically whenever possible.

In considering the suitability of patients for treatment with I^{131}, attention must be paid to previous antithyroid medication or the use of substances containing stable iodine. The latter may depress the capacity of the thyroid to take up radioiodine for months, thus invalidating the accuracy of tracer tests as well as interfering with the therapeutic localization of the radioisotope within the gland. A list of materials containing significant amounts of stable iodine includes most of the radiopaque contrast agents, numerous cough and asthma remedies, certain external medicaments, etc. Whenever possible, an interval of at least two or three months should elapse between the use of these materials or antithyroid iodine medication and the administration of radioiodine. The requisite interval following the use of propylthiouracil and

similar compounds may be appreciably shorter, but in our experience their effect may persist for as long as a month.

Despite the acceptance of younger patients for treatment with radioiodine in some clinics, our present policy is to reject thyrotoxic patients under the age of forty, except in the presence of postoperative recurrence, or under other unusual circumstances. This policy is based on the theoretical hazards of late carcinogenesis or genetic damage. Revision of this policy may be possible with the passage of time. Exceptions were made for various reasons in 37 patients below age forty among the 138 without recurrent postoperative thyrotoxicosis; of these only 15 were under thirty.

At present we consider radioiodine the treatment of first choice in the following types of thyrotoxic patients: (*a*) those above age forty without demonstrable goiter or with diffuse goiters up to approximately 80 to 100 gm. estimated weight; (*b*) patients of any age with persistent or recurrent postoperative thyrotoxicosis. Pregnancy is considered a definite contraindication.

SUMMARY

1. The results of treatment with radioiodine are reported in 180 thyrotoxic patients who have been followed for intervals varying from one to five years after treatment.

2. Thyrotoxicosis was relieved after a single treatment in about 80 per cent and after one or more treatments in 97.2 per cent of these patients.

3. Thyrotoxicosis was relieved in all of 42 patients with postoperative recurrences, and all of 15 patients with nodular goiters.

4. The incidence of protracted postherapeutic hypothyroidism was 18.3 per cent.

5. The incidence of severe post-therapeutic reactions was low (2.8 per cent). One patient, treated under unfavorable circumstances, died of causes related to thyrotoxicosis or the use of radioiodine, a mortality rate of 0.6 per cent.

6. There was poor correlation between the therapeutic results and the administered dose in millicuries and the calculated dose in rads.

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REFERENCES

1. WILLIAMS, R. H., editor: Textbook of Endocrinology. Philadelphia, W. B. Saunders Co., 1950.

2. HAMILTON, H. B., AND WERNER, S. C.: Effects of Sodium Iodide, 6-Propylthiouracil, and 1-Methyl-2-Mercaptoimidazole During I^{131} Therapy of Hyperthyroidism. J. Clin. Endocrinol. **12**: 1083–1094, August 1952.

3. MARINELLI, L. D., QUIMBY, E. H., AND HINE, G. J.: Dosage Determination with Radioactive Isotopes. Practical Considerations in Therapy and Protection. Am. J. Roentgenol. **59**: 260–281, February 1948.

4. FREEDBERG, A. S., KURLAND, G. S., CHAMOVITS, D. L., AND URELES, A. L.: A Critical Analysis of Quantitative I^{131} Therapy of Thyrotoxicosis. J. Clin. Endocrinol. **12**: 86–111, January 1952.

5. RALL, J. E., SONENBERG, M. S., ROBBINS, J., LAZERSON, R., AND RAWSON, R. W.: The Blood Level as a Guide to Therapy with Radio-iodine. J. Clin. Endocrinol & Metab. **13**: 1369–1377, November 1953.

6. SALTER, W. T., DEVISSCHER, M., MCADAMS, G. B., AND ROSENBLUM, I.: Changes In Blood Iodine Fractions and Radioactivity Under Therapy. J. Clin. Endocrinol. **11**: 1512-1523, December 1951.

7. SOLEY, M. H., MILLER, E. R., AND FOREMAN, N.: Graves' Disease: Treatment with Radio-iodine (I^{131}). J. Clin. Endocrinol. **9**: 29–35, January 1949.

8. DOBYNS, B. M., VICKERY, A. L., MALOOF, F., AND CHAPMAN, E. M.: Functional and Histologic Effects of Therapeutic Doses of Radioactive Iodine on the Thyroid of Man. J. Clin. Endocrinol. & Metab. **13**: 548–567, May 1953.

9. SEED, L., AND FIELDS, T.: Treatment of Toxic Goiter with Radioactive Iodine. American Lecture Series 197, Springfield, Ill., Charles C Thomas, 1953.

10. SEED, L., AND JAFFÉ, B.: Results of Treatment of Toxic Goiter with Radioactive Iodine. J. Clin. Endocrinol. & Metab. **13**: 107–119, January 1953.

11. GORDON, E. S., AND ALBRIGHT, E. C.: Treatment of Thyrotoxicosis with Radioactive Iodine. J.A.M.A. **143**: 1129–1132, July 29, 1950.

SUMARIO

El Tratamiento de la Tirotoxicosis con Radioyodo

Preséntase el resultado de la radioyodoterapia en 180 enfermos que tenían tirotoxicosis y fueron mantenidos en observación durante uno a tres años después del tratamiento. Este número comprendió a 42 sujetos que tenían recurrencias postope-

ratorias y a 138 que no habían sido tratados antes o habían recibido preparaciones antitiroideas sin remisión permanente. La tirotoxicosis se alivió aproximadamente en 80 por ciento de los enfermos a continuación de un solo tratamiento y en 17 por ciento más después de uno a tres tratamientos subsiguientes. Se aliviaron todos los enfermos (42) que tenían recurrencias postoperatorias y todos (15) los que tenían bocios nodulares.

La selección de la cantidad exacta de I^{131} que iba a administrarse se basó principalmente en el juicio clínico. La dosis inicial no fué por lo regular inferior a 6 milicuries ni superior a 10 milicuries, administrándose las dosis más pequeñas a los enfermos que tenían glándulas pequeñas y mayor absorción de las dosis exploradoras en el tiroides. Fué mala la correlación entre el resultado terapéutico y la dosis administrada en milicuries o la dosis calculada en rads.

La incidencia de reacciones generales adversas (exacerbación de la tirotoxicosis; precipitación de síntomas cardíacos) fué baja (2.8 por ciento). Un enfermo, tratado en circunstancias desfavorables falleció de causas relacionadas con la tirotoxicosis o el uso del radioyodo. En 18.3 por ciento de la serie hubo prolongado hipotiroidismo.

En la actualidad, los AA. consideran que el radioyodo es el tratamiento de elección en: (1) enfermos de más de 40 años de edad sin bocio observable o con bocio difuso de un peso calculado hasta de 80 a 100 gm. y (2) en todos los enfermos que tengan tirotoxicosis postoperatoria persistente o recurrente. El embarazo constituye una contraindicación bien definida.

DISCUSSION

Warren J. Zager, M.D. (Los Angeles): I would like to make a few remarks particularly with regard to the finding of cramps in these patients. At the Cedars of Lebanon Hospital we have found that a fairly large number of persons have cramps not only after treatment but also before any treatment with radioiodine. Our experience is that these patients lose calcium during their hyperthyroid phase. All of us know that osteoporosis, which is a roentgen manifestation of prolonged absorption of calcium from the bones, is found in prolonged hypermetabolism. After the hyperthyroid state has been eliminated, the bones are hungry for calcium and withdraw this element from the blood stream. There is a tremendous rush of calcium from the blood back to the bony structures, resulting in what you might call a relative hypoparathyroidism.

We have followed several cases with Sulkowitch tests on the urine and with blood calcium tests. I might add that it is very important to do total blood protein determinations at the same time the blood calcium determinations are made, because an evaluation of the true calcium state of the patient can only be obtained in the light of the two tests considered together.

We have treated patients who have had cramps not only with thyroid but also with a preparation of calcium gluconate and vitamin D. Some of the patients have not responded to the ordinary dosage which might be obtained with capsules or tablets of calcium and have had to take powdered calcium gluconate in doses of a heaping tablespoonful two or three times a day. In addition, we have given them oleum percomorph or Hytakerol and in some cases large amounts of milk. Along with milk we also prescribe Amphogel, which binds phosphorus and thereby increases calcium absorption.

In regard to treatment of the hyperthyroid pregnant woman: as you know, one of the complications of treatment of the pregnant woman with iodides or with thiouracil drugs is the fact that a goitrous baby may result. I believe that x-ray therapy to the thyroid gland of the mother might be used to produce a remission of her disease; after the baby is delivered, definitive treatment with antithyroid drugs or radioiodine may be carried out safely.

Donald S. Childs, Jr., M.D. (Rochester, Minn.): I do not think that Dr. Chamberlain needs to offer any apology for what he considers a high incidence of hypothyroidism following treatment. The dosage which he used was from 6 to 10 millicuries, and that is higher than some of the previously reported series he mentioned. He is controlling a very large percentage with a single dose. Furthermore, the majority of his patients are in the older age group; many have severe disease or postoperative recurrences in which rapid control with a single dose may be highly desirable. In his attempt to achieve rapid control of the disease in a high percentage of patients, he has induced hypothyroidism in some of the patients. After all, hypothyroidism is easily reversed by the administration of thyroid medication and should not be considered as a major complication of treatment.

Use of Urokon (Sodium-3-acetylamino-2,4,6-triiodobenzoate)[1] in Roentgen Study of the Gastrointestinal Tract[2]

WILMA I. CANADA, M.D.

AT TIMES IN examination of the gastrointestinal tract the need arises for a contrast material other than a particulate substance such as barium sulfate. If barium enters obstructed bowel or an abscess cavity from which it cannot be removed, it may become inspissated. In the opinion of some surgeons, the danger of impaction, partial or complete, then becomes a definite hazard.

In the search for a thin, non-absorbable contrast substance, the possibility of utilizing Urokon (sodium-3-acetylamino-2,4,6-triiodobenzoate) was investigated. A simple experiment to compare its properties with those of barium sulfate was performed.

A suspension of one part USP barium sulfate to one part water and a 30 per cent solution of Urokon were compared by allowing equal volumes of each substance to run from a 1-c.c. pipette. The time required and the number of drops produced were recorded. Equal quantities of each substance were also placed in the center of a piece of filter paper, and after two minutes the diameters of the wet spots were determined. The results, shown in Table I,

TABLE I: COMPARISON OF PROPERTIES OF BARIUM SULFATE, USP, AND 30 PER CENT UROKON[3]

Experiment A: 1 c.c. of each substance was put into a 1-c.c. pipette and the time required for it to run out was noted. Pipette held at same angle in each instance.

Material	Number Drops	Volume	Time
Barium	15*	0.7 c.c.	2'30"
Urokon	Ran out in stream (end of stream, 5 drops)	0.9 c.c.	1.5" 5"

Experiment B: 5 c.c. of each substance dropped on filter paper.

Material	Time	Size of Spot
Barium	2'	Wet area 5.5 cm. in diameter. Barium remained in single mass 1.3 cm. in diameter and did not flow across or soak into filter paper.
Urokon	2'	8 cm.

* It was necessary to shake pipette three times.

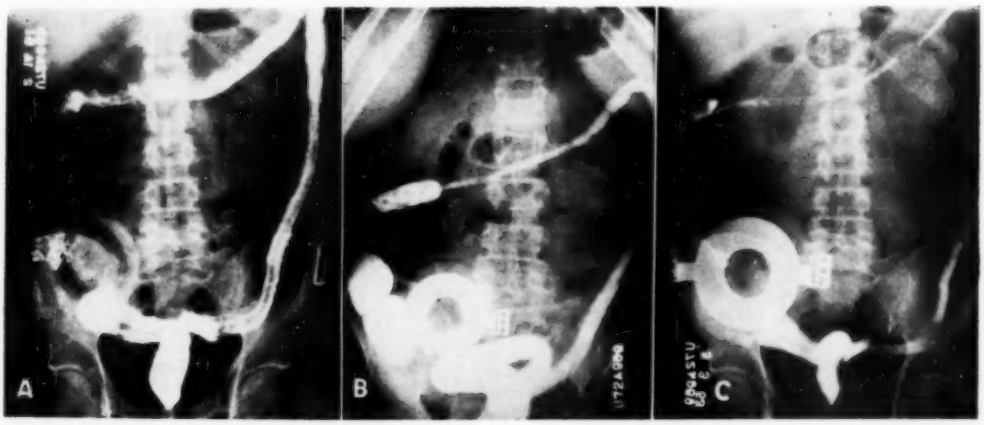

Fig. 1. Case 1: Ulcerative colitis. A. Barium enema (Feb. 14, 1951). B. Umbrathor enema (May 6, 1952). C. Enema using 30 per cent Urokon (March 4, 1953). Except for changes which would be expected with progress of the disease, there is little difference between these examinations. There is *no* visible urinary excretion of the Urokon.

[1] The material for this study was furnished by the Mallinckrodt Chemical Works, St. Louis, Mo.

[2] From the Department of Radiology, Massachusetts General Hospital, Boston, Mass. Accepted for publication in June 1954.

TABLE II: RESULTS OF UROKON EXAMINATIONS

Case	Age, Sex	Diagnosis	Reason for Examination	Examination with Urokon Percentage, Amount, How Administered	What was Demonstrated	Confirmation of Findings
1.	58 M	Chronic ulcerative colitis	Follow-up enema. Patient unable to evacuate well on previous examination	30% Amount not recorded Rectal tube	Contracted colon, well outlined	Subtotal colectomy one year later
2.	38 F	Chronic ulcerative colitis	Same as 1	15% 150 c.c. Rectal tube	Same as 1	Symptoms improved with ileostomy. No operation
3.	22 F	Carcinoma of sigmoid (perforated with abscess formation)	Avoidance of impaction of barium in abscess cavity	70% Amount not recorded Rectal tube	1st exam.: Perforation of narrowed sigmoid and abscess cavity 2nd exam.: Nodular filling defects obstructing flow of Urokon	Exploration, drainage of abscess, biopsy of tumor masses. Histologic diagnosis: Adenocarcinoma
4.	56 F	Perforated cystic leiomyosarcoma of jejunum	Small bowel obstruction suspected	30% About 120 c.c. Harris tube in stomach	Multiple fluid and air-containing extraluminal cavities in communication with small bowel	Operation with resection of tumor and segment of jejunum. Histologic diagnosis: Leiomyosarcoma
5.	41 F	Abdominal carcinomatosis from carcinoma of ovary	Same as 4	30% Amount not recorded Harris tube in distal small bowel	No obstruction. Multiple extrinsic pressure defects on distal ileum	Barium enema next day, with same findings. No operation. Few weeks later, patient moribund, with tumor growing through abdominal wall
6.	79 M	Cutaneous fistula following postgastrectomy subphrenic abscess	Risk of barium clogging tract or obscuring future study	30% 50 c.c. Levine tube in distal esophagus	Fistula, later smaller	Fistula healed and patient well few months later
7.	67 F	Postoperative small bowel obstruction due to adhesions	Possibility of persistent obstruction	30% Amount not recorded Harris tube in ileum	Normal ileum	Patient did well immediately postoperatively after removal of tube
8.	48 M	Post-gastrectomy (peptic ulcer) pancreatitis; ileus	Small bowel obstruction suspected	30% "Large volume" (exact amount not recorded) Rectal tube; proximal and distal jejunostomy tubes	Gastric stump. Dilated small bowel without obstruction. Urokon in terminal ileum 24 hours later	Improved spontaneously during next six weeks. No operation
9.	53 F	Distention following revision of colostomy	Obstruction suspected	70% 60 c.c. Harris tube in duodenum	First and second portions of duodenum. Reason for failure to outline bowel distal to this not demonstrated	Improved without operation

TABLE II: RESULTS OF UROKON EXAMINATIONS (*Continued*)

Case	Age, Sex	Diagnosis	Reason for Examination	Examination with Urokon Percentage, Amount, How Administered	What was Demonstrated	Confirmation of Findings
10.	62 M	Distention following colectomy	Obstruction suspected	30% 100 c.c. Levine tube in stomach	Entire dilated small bowel	Improved slightly but died a few months later of metastatic carcinoma
11.	15 mo. F	Diabetic acidosis	High small bowel obstruction suspected	30% Amount not recorded Levine tube in stomach	Normal stomach and duodenum	Recovered completely with control of diabetes
12.	51 F	Metastatic carcinoma of breast; abdominal carcinomatosis	Obstruction suspected. Free air in peritoneal cavity, source unknown	30% 120 c.c. Harris tube in proximal stomach	Normal stomach and duodenum	Laparotomy revealed perforation of cecum, carcinomatosis, normal upper gastrointestinal tract
13.	16 F	Chronic ulcerative colitis	Injection of fistula. Possibility of abscess	30% 50 c.c. Small rubber catheter in fistula	Rectocutaneous fistula. No abscess	Excision of rectum and fistula. Histologic findings: thickened, chronically inflamed rectal mucosa with few tiny superficial ulcerations; fistulous tract lined with granulation tissue

indicate that barium is thicker than Urokon, tends to clog a small opening, and does not spread as rapidly on filter paper. The outcome of this experiment was interpreted as confirming by physical means the assumption that Urokon is less viscous than barium and penetrates more readily into small fistulas and cavities.

So far as is known, the only previous reference to the employment of Urokon for the study of the gastrointestinal tract is in an article by Nesbit and Lapides (1). These authors, primarily interested in the medium for the purposes of excretory pyelography, refer briefly to the trial of a 15 per cent solution in examination of the upper gastrointestinal tract.

The present study reports the results of Urokon examination of the gastrointestinal tract carried out at the Massachusetts General Hospital in 13 cases, details of which are presented in Table II (see also Figs. 1–8).

The main advantage of Urokon over barium in the study of the gastrointestinal tract lies in its composition; it is a thin liquid which, as pointed out above, penetrates small tracts and cavities readily and does not become inspissated. In the cases studied, Urokon disappeared rapidly from fistulas and abscess cavities, presumably by absorption or diffusion, thereby allowing subsequent contrast examinations, if required, without the confusion of residual opaque material. It proved quite adequate for the study of ulcerative colitis, especially with defunctioned colons. Umbrathor has previously been used for similar reasons (2), but it has the disadvantage of radioactivity and is no longer available commercially.

Other factors to be considered in a contrast substance are fluoroscopic visability and film density. In most of the cases, though Urokon provided slightly less contrast than barium, both of these requirements were met satisfactorily. In the one infant examined (Case 11), the fluoroscopic image appeared as dense as with barium. Because further dilution by fluid within the bowel or cavity being studied

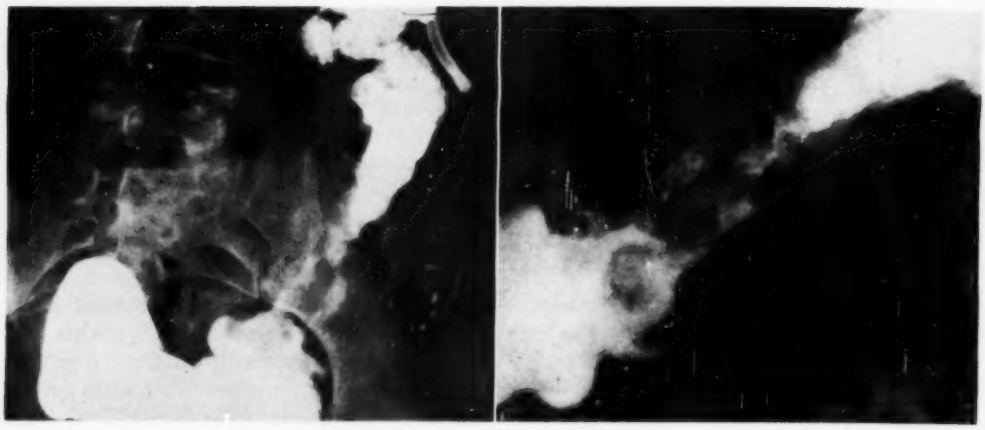

Fig. 2. Case 3: Carcinoma of sigmoid (residual barium within the colon from examination at another hospital). Urokon, 30 per cent, was injected into the rectum. Roentgenogram shows a partially lobulated 10-cm. defect in the sigmoid. Some contrast substance lies within a 9-cm. cavity extrinsic and lateral to the colon. *No pyelogram* was visible on the full-size films.

Fig. 3. Case 3 (two months later than Fig. 2): Complete obstruction to the retrograde flow of Urokon at the site of the previously demonstrated filling defect. Two large intraluminal masses are outlined.

may occur, less than a 30 per cent solution would usually not be satisfactory. However, in 1 case of ulcerative colitis with a defunctioned colon of very small caliber (Case 2) a 15 per cent solution produced excellent visualization. In several instances, a somewhat unsatisfactory examination could be attributed to poor preparation of the patient or to a lack of cooperation on the part of a very ill patient rather than to the medium used.

Several distinct disadvantages of the use of Urokon in examination of the gastrointestinal tract must be kept in mind. Absorption of the material occurred in at least 4 of the 13 patients studied, as evidenced by the appearance of faint or distinct excretory pyelograms a short time after administration. In 2 others there was questionable evidence of contrast material in the renal collecting systems, and in 2 cases appropriate films for demonstration of pyelograms were not obtained. Two of those patients showing definite pyelograms had ulcerative colitis; 1 had an abscess communicating with the bowel. In the fourth patient, who had paralytic ileus following a colectomy, there was no reason to suspect any communication of the bowel lumen with the blood stream.

The series examined is too small to exclude the possibility of absorption through intact intestinal mucosa. Although no ill effects occurred in the present group, since

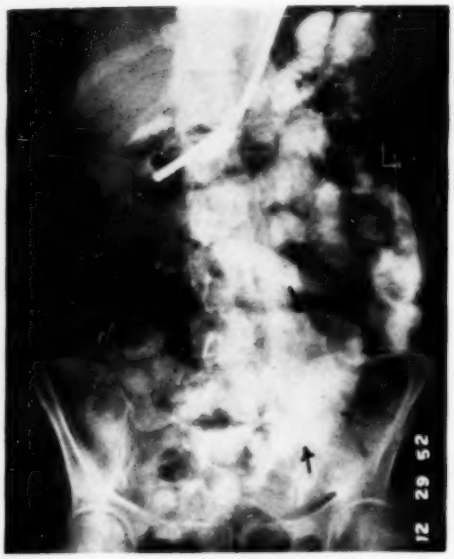

Fig. 4. Case 4: Leiomyosarcoma of jejunum. Urokon, 30 per cent, was introduced into the stomach through a Harris tube, the tip of which lay in the body of the stomach. The contrast material subsequently flowed through the entire small bowel. An irregularly outlined, roughly square fluid- and air-containing extraluminal cavity in the left lower abdomen is demonstrated, corresponding to the perforated tumor and abscess cavity removed surgically. A *faint pyelogram* was visible on the right on the original film; the left kidney is obscured.

the material is sometimes absorbed, allergic reactions or iodism are theoretical possibilities. This, however, would be even less a problem than the occasional reaction encountered in intravenous administration of Urokon.

The extremely bitter taste of the material makes the use of a tube obligatory for its introduction into the upper gastrointestinal tract. Attempts are being made by the manufacturers to produce a more palatable preparation, but they have not yet been successful. Although a 70 per cent solution was employed in 2 instances without side-effects, the routine use of the higher concentrations is not recommended. Vomiting occurred in the one patient (Case 9), in whom the 70 per cent Urokon refluxed from the duodenum into the stomach.

Mucosal coating is not as good with a solution as with a suspension, and the Urokon solution is so thin that it probably would not be visible in the small quantities that might adhere to the mucosa. This, however, was not a significant drawback in obtaining the desired information from the examinations performed.

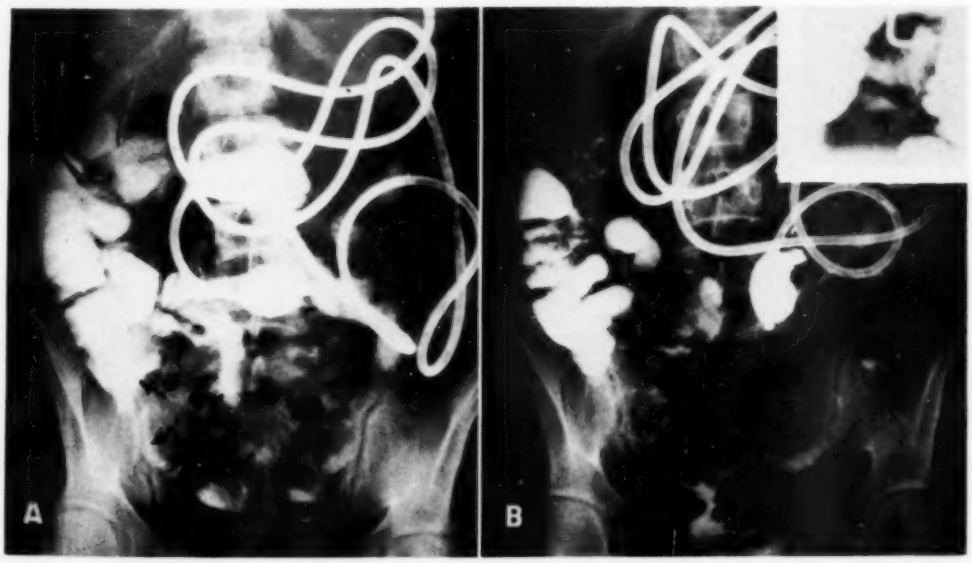

Fig. 5. Case 5: Metastatic carcinoma of ovary. A. Injection of Urokon through a Harris tube demonstrated no obstruction. Arrows indicate sites where several of the small bowel loops appear irregularly narrowed and partially fixed, probably by masses extrinsic to the bowel. *No pyelogram* is recognized. B. A barium enema on the following day confirmed the impression obtained from the Urokon study.

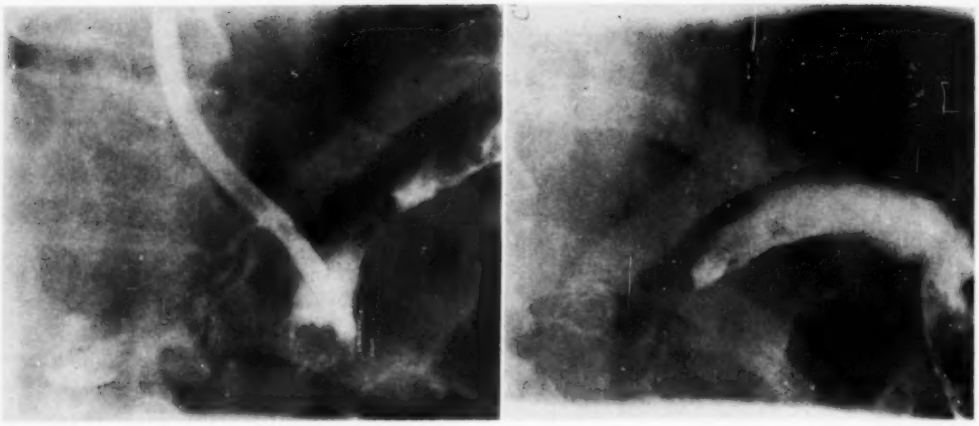

Fig. 6. Case 6: Postgastrectomy fistula. Through a Levine tube placed in the distal esophagus, 50 c.c. of 30 per cent Urokon was injected. A curved tract nearly 2 cm. wide is outlined beneath the fixed left leaf of the diaphragm, above and lateral to the splenic bed. Air and contrast material are seen in the sinus tract. Appropriate films for demonstration of a pyelogram were not obtained.

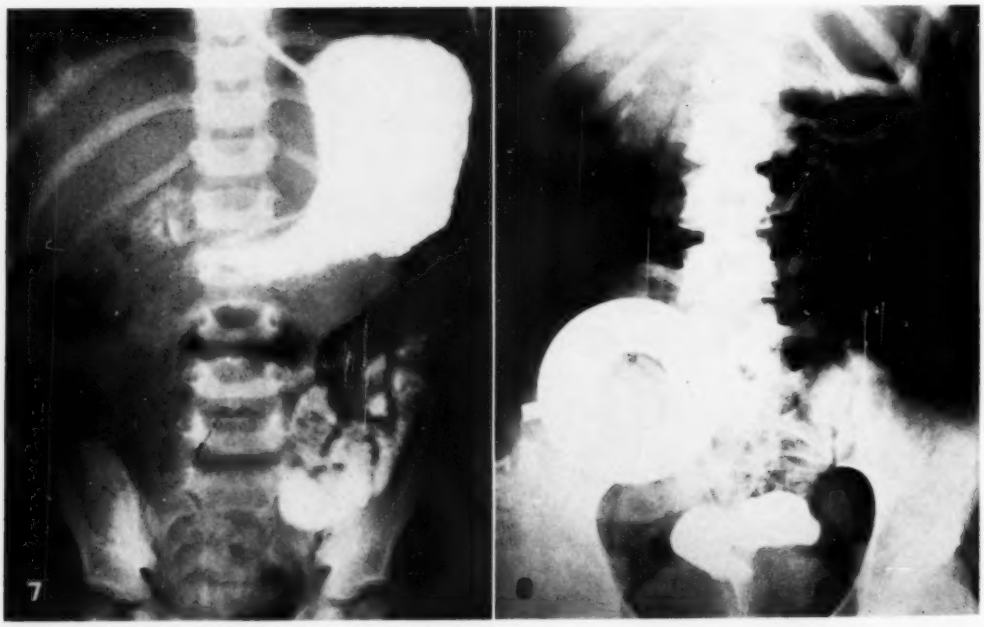

Fig. 7. Case 11: Diabetic acidosis. Urokon, 30 per cent, introduced into the stomach through a Levine tube outlines a rather hypoactive but otherwise normal stomach. The duodenum is not well shown. There is no evidence of high small bowel obstruction. Appropriate films for demonstration of a pyelogram were not obtained. (The density of the contrast material is quite satisfactory.)

Fig. 8. Case 13: Ulcerative colitis. A film of the abdomen obtained about one hour after the injection of a fistula between the rectum and skin of the lower abdomen showed a distinct bilateral pyelogram, indistinctly reproduced here.

As Urokon is now provided commercially, it has two great disadvantages. It is expensive in the large quantities necessary for the type of examination here described, and the ampules in which it is furnished are too small for convenience.[3]

CONCLUSIONS

The use of a 15 to 70 per cent Urokon solution in roentgen study of the gastrointestinal tract has application in certain instances where the use of barium sulfate suspensions is contraindicated. Urokon is somewhat less dense, and mucosal coating is less adequate; therefore the examinations are less satisfactory for diagnostic purposes. The medium can be used to advantage, however, to outline dilated or defunctioned bowel, fistulas, abscess cavities, perforations, and the colon in cases of ulcerative colitis. A major disadvantage is the cost. A less expensive, bulk material, which need not be sterile, could be substituted.

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[3] Urokon, 70 per cent, is now supplied by Mallinckrodt Chemical Works in 50-c.c. bottles.

REFERENCES

1. NESBIT, R. M., AND LAPIDES, J.: Observations on Urokon, A New Excretory Pyelographic Medium. Univ. Michigan M. Bull. **16**: 37–42, February 1950.
2. SHULL, H. J., SCHULZ, M. D., AND JONES, C. M.: Roentgen Examination of Defunctioned Colon after Ileostomy with Special Reference to Safety and Practical Value of Thorium Dioxide as Contrast Medium. Gastroenterology **12**: 1–9, January 1949.

SUMARIO

El Uso del Urokón[R] (Sodio-3-acetilamino-2,4,6-triyodobenzoato) en el Estudio Roentgenclógico del Tubo Gastrointestinal

En 13 casos, aquí tabulados, lleváronse a cabo exámenes del tubo gastrointestinal con el Urokón como substancia de contraste. Los resultados conducen a las conclusiones siguientes: El uso de una solución al 30 a 70 por ciento de Urokón en el estudio roentgenológico del tubo gastrointestinal tiene aplicación en ciertos casos en que está contraindicado el empleo de suspensiones de sulfato de bario. El Urokón es algo menos denso y el revestimiento de la mucosa es menos adecuado, por lo cual, el examen es menos satisfactorio para fines de diagnóstico. Sin embargo, puede usarse con ventaja para demarcar un intestino dilatado o afuncionante, fístulas, cavidades de abscesos, perforaciones y el colon en casos de colitis ulcerada. Una desventaja considerable es el costo. Como substituto, podría emplearse una substancia menos cara en bulto, que no tendría que ser estéril.

EDITORIAL

The Need for Accuracy in Cephalopelvimetry

Several statistical surveys of the clinical results obtained with two different methods of roentgen cephalopelvimetry have been published in the past five years, and a third one is in preparation. It has been shown that the roentgen prediction of delivery uncomplicated by cesarean section was correct in 94 to 99 per cent of cases in which the radiologist diagnosed absence of disproportion. This is valuable negative information. The prediction of obstetrical complications was also correct in 80 to 93 per cent of patients in whom the radiologist diagnosed a high degree of disproportion. Of the assessable patients in whom this unfavorable prognosis was made, 77 to 83 per cent required cesarean section for cephalopelvic disproportion.

On first consideration these figures may seem adequate. Under closer scrutiny, however, those methods which are generally considered the most accurate among the multitude of existing systems of obstetrical roentgenometry appear deficient in respect to the size of their borderline group. Even though the above statistics show that a definitely favorable roentgen prognosis stands an excellent chance of being correct, and that a definitely unfavorable roentgen prognosis stands a fair to good chance of being true, there is an inordinately large number of cases in which the roentgen diagnosis is less definite. These cases are labeled "borderline disproportion" or a reasonable equivalent of that term. Each roentgen diagnosis of borderline disproportion represents a failure of the method and the radiologist's indecision as to presence or absence of disproportion.

Radiologists can mitigate the adverse effect of a large borderline group by dividing it into "minimal," "mild," "moderate," and "marked" borderline disproportion. They cannot alter the fact, however, that under present conditions only the two definite groups at either end of the scale, namely the "no disproportion" and the "high disproportion" group, have any worth-while statistical chance of containing correct predictions. If one alters the classification of roentgen criteria so that these two groups are made to include larger numbers of cases, one can reduce the borderline group, but the statistical accuracy becomes so poor that the clinical usefulness of the method is lost.

The size of the borderline groups with each of the three methods of cephalopelvimetry can be learned from statistics dealing with their clinical accuracy. From them, it is apparent that in all three the borderline cases are more numerous than cases of "high disproportion." The borderline group is actually one and a half to four and a half times larger than the "definite" disproportion group, comprising 11 to 31 per cent of all cases examined. This is a highly undesirable condition. The principal reasons for this deficiency are fourfold: physical inaccuracy of measurements; errors in statistical technic; the anatomical ambiguity of those dimensions of the pelvis and the fetal skull which are commonly regarded as significant in cephalopelvimetry; and finally the most fundamental reason, biologic variation.

Physical Inaccuracy: Experiments have shown that, with the best conventional methods of correction, there is inherent in measurements of the pelvis an actual error of ±1 mm., and in those of the fetal skull ±2 mm. The total error of the measured disproportion is thus ±3 mm. if every dimension is individually corrected for false enlargement according to its distance from the

film. Though the theoretical geometrical error is thus reduced to zero, the actual error is ±3 mm., and the difference between the extreme positive and the extreme negative error is 6 mm. The entire permissible spread of a borderline group is hardly ever greater.

The amount of borderline group spread allowed by different authors for the methods which they use varies. Erskine and collaborators, using the Chassar Moir graph method, allowed a borderline spread of 4 mm. for the measured biparietal diameter of the fetal skull at the inlet and 7 mm. at the mid-pelvis and outlet. Moloy and Steer accept a total borderline spread of 7 mm. between the largest and the smallest circle difference permitted at the inlet or at the mid-pelvis. A reclassification of criteria for the Ball method resulted in permitting a volume difference of 70 c.c. at the inlet and of 170 c.c. at the mid-pelvis. This corresponds to a diameter difference between two spheres amounting to 4 mm. at the inlet and 9 mm. at the mid-pelvis, which indicates that the physical error alone makes up most or all of the borderline group.

It is obvious that, in order to reduce the size of the borderline group, one must increase the physical accuracy of roentgen measurements. It is entirely possible to obtain precision measurements of the pelvis with an accuracy of ±0.2 mm. by methods which are not now in general use but which are neither burdensome nor complicated. The problem of precise fetal skull measurements is more complex but not beyond solution.

It is regrettable that there is a trend toward approximate pelvimetry which is contrary to the need for further improvement and represents a move in the wrong direction. In order to make roentgenometry more "convenient," proponents of these approximate methods have advocated the use of false centimeter scales which apply the same correction factor to all patients regardless of individual variations in body size. By employing moderately long target-film distances of 1.5 to 2.0 meters, they have succeeded in keeping the geometrical error within ± 2 to 3 mm. This geometrical error is superimposed upon the actual physical error, so that the total error may rise to ±6 mm. with a total spread of 12 mm. This practice at least doubles the number of cases falling into the borderline group, which is already too large. The ultimate goal should be in the opposite direction, namely a physical error of negligible size so that all the borderline group is taken up by biologic variation. Progress will come only from precision measurements.

Errors in Statistical Technic: With all methods reviewed, classification is based on a borderline group of uniform width, independent of the absolute size of the pelvis and the fetal head. This is a statistical error. By charting the results obtained with any biometric method on graph paper, one obtains a borderline group the contours of which converge toward the zero point, *i.e.*, the width of the borderline group becomes smaller when the measurements are smaller. By working up the results obtained with roentgen cephalopelvimetry in this manner, one can reduce the size of the borderline group considerably. At present its width is adjusted to the largest measurements occurring in obstetrical practice and does not converge.

Anatomical Ambiguity: With the exception of the Moloy-Steer method, in which a disk is fitted into the pelvic inlet, all measurements are based on the assumption that pelvic diameters control the size of the fetal head that can pass. Actually, however, the standard anatomical diameters of the pelvis are hardly ever fully representative of the limits of the birth canal. The most obvious example of anatomical ambiguity is the role of the interspinous diameter in the evaluation of the mid-pelvis. This pelvic dimension usually forms a chord to the circle of the passing fetal head, *i.e.*, the head diameter may be larger than the bispinous diameter without adversely affecting the obstetrical outcome. In short, the fetal head may

pass in front of or behind this pelvic dimension. It is the *available* diameter and not the anatomical one which determines the presence or absence of cephalopelvic disproportion.

In order to obtain more significant anatomical landmarks, Italian workers have employed laminagraphy for the purpose of delineating the entire osseous cross section of the birth canal at any level. This is a promising forward step and will result in narrowing the borderline spread of the roentgen diagnosis of mid-pelvic disproportion, which up to now has been the most difficult to make. Laminagraphy will enable us to visualize for the first time the anterior border of the mid-pelvis. Once this information is obtained, one can determine with ease the available diameter of the head circle passing through the mid-pelvis. Obstetricians agree that an accurate roentgen diagnosis of mid-pelvic disproportion is more important than the inlet or outlet dimensions. Laminagraphy will contribute greatly to the clinical accuracy and usefulness of cephalopelvimetry and reduce the number of borderline cases.

Biologic Variation: Finally, one must turn to the problem of biological variation, which contributes much to the undesirable size of the borderline group. Even under the most uniform conditions as to race, sex, weight, age, and body size, a sizable variation will be found for any biological function. The spread of the borderline group for a single biologic function is 33% of the median. This corresponds to a variation of the median by ±17%. A borderline spread of this magnitude is a fundamental law of nature and can be found everywhere in biology. In cephalopelvimetry the factors are not uniform. The biological variation is, therefore, greater. The problem may seem insurmountable, but this is by no means the case. In clinical medicine we have learned to cope with this problem by basing our diagnosis not on a single test but on a multiplicity of criteria. By using a multiplicity of criteria we have reduced successfully the adverse effect of the biological variation of each. This universal principle can be and has been applied to obstetrical roentgenometry.

At first an attempt was made to correlate a single pelvic diameter with the obstetrical outcome. Later separate diameters for inlet, mid-pelvis, and outlet were measured. The next step consisted in establishing an index comprising two diameters, such as the sum of an anteroposterior and transverse dimension at a pelvic level, and using it as a criterion. The next development included the measuring of the biparietal diameter of the fetal head. Soon it was found necessary to express disproportion by comparing this skull diameter with a pelvic index (Chassar Moir), and finally we arrived at comparing a pelvic index with a skull index, such as two circles in the method of Moloy and Steer, two spheres in the Ball method, and two diameter products in the system of Coe.

There is no cause for resting at this point. Further factors influencing the obstetrical outcome must be measured and included in the process of roentgenometry. Measurements of the length of the birth canal, for instance, could be incorporated into pelvic indices. Present-day cephalopelvimetry is based on delineating the osseous border of the pelvis and the fetal skull. Megavoltage radiography and contrast injections will make it possible to delineate the soft-tissue borders of the structures participating in the birth process and include them in the measurements. In Sweden, Sundberg, Lindgren, and Ljungström use electronic strain gauges to measure continuously the uterine pressure during labor. An electronic device recording the intracranial pressure of the fetus may be anticipated in the future. When we have succeeded in correlating uterine pressure and fetal intracranial pressure to the degree of cephalopelvic disproportion as determined by x-rays, we shall have succeeded in making the most accurate and useful information possible available to the obstetrician.

GERHART S. SCHWARZ, M.D.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Cardiovascular System

RADIOISOTOPES

RADIATION EFFECTS; EXPERIMENTAL STUDIES; RADIOBIOLOGY

RADIOPHYSICS; RADIOCHEMISTRY

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Metastasizing Meningioma. Karel Liška. Acta radiol. & cancerol. bohemoslov. **8**: 139–144, May 1954. (In Czechoslovakian)

Metastasizing meningiomas are exceedingly rare. According to the author, only 9 cases have been recorded, to which he adds a tenth. Five of the cases were seen in men; 5 in women. The age range was from twelve to seventy-two years; only 4 patients were over forty. Most of the metastatic lesions were observed in the lungs; less frequently metastases were found in the pleura, mediastinum, liver, kidneys, and lymph nodes.

The author's patient was a 68-year-old man who underwent a nephrectomy in the autumn of 1951 because of a non-specific pyelonephritis with abscess formation. During hospitalization he began to suffer from dizziness and vertigo; later, swelling and pain occurred in the left frontal area. Roentgenograms in 1952 showed a bone defect, about 3.5 cm. in diameter, in this region, the diagnosis resting between gumma and tumor of the frontal bone. Operation was performed and the histologic diagnosis was "proliferating meningoblastoma." Shortly thereafter the patient began to complain of intense pain in the sacrum, but x-ray examination revealed no abnormalities other than spondylosis, for which irradiation was prescribed. At a later admission the patient was markedly cachectic, pain over the sacrum had increased, and urination was difficult. Roentgenograms now showed an irregular rarefaction in the sacral spine. At necropsy, two small areas of recurrent tumor were found at the site of the operation in the frontal region, as well as a large tumor destroying the 1st and 2nd sacral vertebrae. As both the cranial lesions and the sacral neoplasm were histologically identical with the primary frontal lesion, the final diagnosis of metastasizing meningioma appeared beyond question.

Five roentgenograms.

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Denver, Colo.

Cerebral Arteriography in the Study of Certain Vascular Diseases. Antonio Toti. Radiol. med. (Milan) **40**: 737–757, August 1954. (In Italian)

The author's personal experience covers 250 cerebral angiographies. Several cases are reported in some detail, demonstrating the angiographic findings in occlusion of the carotid artery and its branches, cerebral sclerosis, cerebral hemorrhage, and aneurysms. These cases indicate that the method can give information not only as to the site and extension of these vascular diseases but also as to their nature. The angiographic signs may be (1) direct, when the lesion is of sufficient size and has involved a vessel of sufficient caliber to be visible radiologically, as in thrombotic interruption of the carotid, aneurysms, or the rigid vascular widening in cerebral sclerosis, or (2) indirect, when the vessels are displaced, as by a superficial hemorrhage.

The author emphasizes that cerebral angiography does not replace air encephalography. Each method at times gives information not possible with the other.

Twenty-four roentgenograms.

Christian V. Cimmino, M.D.
Fredericksburg, Va.

The Relationship Between the Third Ventricle and the Basilar Artery. T. Greitz and S. Löfstedt. Acta radiol. **42**: 85–100, August 1954.

The relation between the floor of the third ventricle and the basilar artery was studied both roentgenologically and at autopsy. Five cases with a basilar impression in the floor of the third ventricle secondary to projection of the basilar artery up into the cisterna pontis or interpeduncularis are presented. From clinical, roentgenologic, and pathologic-anatomic observations the authors have found that the deformation of the third ventricle caused by the basilar artery occurs only when the latter is enlarged. This enlargement they believe to be caused principally by damage to the elastic tissue in the vessel, combined with hypertension. Such protrusion of the long basilar artery into the floor of the ventricle may simulate a tumor in the hypothalamus, pons, or basal cistern, or an aneurysm in the basilar bifurcation. Vertebral angiography is then necessary to provide a complete roentgenologic investigation.

Fifteen roentgenograms; 10 drawings.

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University of California, S. F.

Spontaneous Thrombosis of the Carotid Arteries. Sidney K. Shapiro and William T. Peyton. Neurology **4**: 83–100, February 1954.

It is the purpose of this presentation to outline the clinical features of unilateral spontaneous thrombosis of the carotid arteries. The material is based on a series of 17 cases from the University of Minnesota Medical School, Minneapolis, in which the diagnosis of spontaneous thrombosis of the carotid arteries was established or strongly suggested. These cases are reported in detail. Sections on the angiographic findings and on ventriculography and pneumoencephalography are included.

Angiography in occlusions of the internal carotid artery may reveal:

1. A conical narrowing of the contrast medium before it stops, resulting in visualization of a stump or short segment of the internal carotid artery.
2. Failure to fill the internal carotid artery and a defect or defects in the column of contrast material produced by the thrombus, extending from the internal carotid artery.
3. Retrograde flow of the medium in the common carotid artery and, on the right side, flow of medium through the innominate artery into the vertebral artery, resulting in a vertebral angiogram.
4. Narrowing of the vessel and irregularities in its diameter.
5. Failure on repeated attempts to produce any filling of the carotid artery.
6. Failure on repeated attempts to produce any filling of the internal carotid artery beyond the carotid siphon.

The first four findings are strong evidence for occlusion of the carotid artery. Where the vessels are narrowed and irregular, a canalization of a thrombus or a partial thrombosis is suggested. Failure of the internal carotid artery to fill at its origin, after repeated attempts at angiography, is suggestive but not diagnostic of internal carotid artery occlusion, since it may well be

due to technical difficulties. Failure of the carotid artery to fill beyond the carotid siphon must likewise be interpreted with reservation, and such a factor as arterial spasm must also be considered.

Angiography was performed in 11 patients in the authors' series, and all the findings outlined above were represented. In 1 patient aphasia developed following angiography on the uninvolved side and pneumoencephalography performed simultaneously under anesthesia.

The characteristic picture following air studies is that of dilatation of the ventricles, particularly on the involved side. A brain tumor may be present in addition to thrombosis of the carotid arteries, and some suggest air studies to supplement angiography. In 2 of the authors' cases the ventriculograms revealed no abnormalities. In another case the pneumoencephalogram was normal.

Four angiograms.

Collateral Ophthalmic Artery Circulation in Thrombotic Carotid Occlusion. Kjeld Vaernet. Neurology 4: 605–611, August 1954.

In cases of occluding vascular lesions of the internal carotid artery, a collateral circulation to insure sufficient blood flow to the corresponding hemisphere will be established primarily by way of the anterior and posterior communicating arteries. The ophthalmic artery must also be regarded as a potentially important collateral pathway in these cases. The influx occurs as a result of anastomotic connections between the terminal branches of the ophthalmic artery and the facial branches of the external carotid.

In most cases the main collateral circulation is derived from the anterior communicating artery and the ophthalmic artery. As a result of this, the anterior cerebral artery receives a greater supply of blood than the middle cerebral artery. This probably accounts for the greater severity of hemiplegia of the arm than of the leg in cases of incomplete occlusion of the internal carotid artery.

The onset of acute episodes may be due to incidental causes, resulting in transient failing of a circulation already impeded by atheromatous changes of the vessels. A sudden onset of occlusion, even when affecting a minor cerebral vessel, may deprive the brain of its blood supply in the territory of that vessel and also, because of associated vascular spasm, result in a varying degree of ischemia of extensive areas of the cerebral hemisphere.

Four cases of thrombosis of the cervical portion of the internal carotid artery are reported.

Three roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California, S. F.

Chronic Epidural Abscess and Condensing Osteomyelitis of the Skull. Aldo Morello and Thomas I. Hoen. Neurology 4: 633–636, August 1954.

The authors report an unusual case of chronic epidural abscess characterized clinically by a right hemiplegia, mental impairment, fever, and a draining sinus in the right frontal parietal area, with associated chronic osteomyelitic changes of the right side of the skull.

The pertinent roentgen findings were: (1) a thickening of the entire right half of the skull, elevation of the right lesser wing of the sphenoid, enlargement of the superior orbital fissure, a defect in the skull, calcification of the falx and dura, and displacement of the pineal, as well as (2) angiographic demonstration of a depression of the pericallosal and callosomarginal arteries and displacement of the anterior cerebral artery away from the lesion, separation of the superior longitudinal sinus from the inner table of the skull, which indicated that the lesion was extradural, and the existence of an avascular area beneath the bone, delimited medially by cortical venous channels.

Presumably the hemiplegia on the same side as the abscess resulted from encroachment of the cerebral peduncle on the tentorium.

Epidural abscesses rarely reach the chronic stage, since, if they are not treated surgically, the outcome is usually fatal. The size of the cavity is ordinarily too small to produce clinical evidence of impaired cerebral function. Calcification of the abscess wall occurs occasionally.

Four roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California, S. F.

Benign Giant-Cell Tumors of Skull and Nasal Sinuses. Ralph Peimer. Arch. Otolaryng. 60: 186–193, August 1954.

A brief review of the literature demonstrates a paucity of cases of benign giant-cell tumor involving the nasal sinuses and skull. The ethmoid sinuses have been reported as the site of origin in about 13 cases, the sphenoid sinus in 4 cases, the frontal sinuses in 4 cases, and the occipital bone in 2 cases.

The author presents 3 cases of benign giant-cell tumor involving (*a*) the maxillary sinus, (*b*) the sphenoids and ethmoids, and (*c*) the roof of the orbit. The first case was treated by excision, the second by radiotherapy, and the third by both excision and radiotherapy. The best clinical result was obtained in the case in which complete excision of the tumor was possible.

Four roentgenograms; 5 photomicrographs.

Cholesteatoma of the Middle Ear. A Clinical and Roentgenologic Study. Lars Winderen and Johannes Zimmer. Acta radiol. Supplement 111, 1954.

The authors reviewed a total of 536 ears with chronic otitis media with special regard to the operative finding of cholesteatoma. Study was limited to the so-called "pseudo-cholesteatoma," defined as a smooth-walled cyst lying in a bony cavity easily detached from its bed, the cyst wall consisting of concentric layers of epithelium. The so-called "true cholesteatoma" (epidermoid tumor), which apparently is congenital, bears no relation to infection, and frequently occurs outside the temporal bone, is not considered.

All cases were seen at the Department of Otolaryngology of Rikshospitalet, Oslo, between 1940 and 1950. In 200, both surgical and roentgenologic data were available. Discussion of the findings is divided between a clinical and a roentgenologic section.

Clinical Section: Onset of aural discharge occurred in the first decade in 60 per cent of the cases, and in the first year of life in two-thirds of these. Of the patients with otitis media surgically treated, 50 per cem had an aural discharge for more than ten years, and 25 per cent for more than twenty years. Serious complaints such as meningitis, labyrinthitis, and abscess were observed in 56 per cent of patients with cholesteatoma and 48 per

cent of those without. There was marginal perforation in 97 per cent of the cholesteatomas. Yet in 32 per cent of the total cases with marginal perforation, cholesteatoma was not disclosed, despite a history of prolonged suppuration. This is a higher percentage than is usually reported.

In cases of chronic otitis media, both with and without cholesteatoma, pneumatization usually was more highly developed than one might believe from previous publications. In the non-pneumatized group, the average duration of aural discharge was longest. It is of interest that in a large proportion of patients with a sclerotic mastoid, suppuration probably did not occur until after completion of cell system development. This lends support to the assumption that prolonged suppuration actually may give rise to a retrogression of the cellular elements of a previously well pneumatized mastoid.

There was a spectacular incidence of complications in the small group showing the best pneumatization, substantiating the conclusion that the more highly developed the cellular system, the greater the tendency to serious complications in the presence of cholesteatoma. Complications occurred with the highest frequency in cases of cholesteatoma involving the antral region, the frequency increasing with the size of the lesion. The authors believe that in a case of chronic otitis media with marginal perforation and a history of discharge for ten to twenty years the likelihood of serious complication is so great that operative treatment should be advised.

Roentgenologic Section: General principles in the roentgen diagnosis of cholesteatoma are outlined as follows: (1) The diagnosis of cholesteatoma must be based on erosion of the bone, with marginal sclerosis surrounding the erosion. (2) The more marked the sclerosis, and the larger the cavity, the more definite the diagnosis. (3) Reactive sclerosis should be distinguished from the sclerosis often accompanying poorly pneumatized bone, and following chronic infection. (4) With increasing pneumatization, the diagnosis is more difficult because the middle ear cavities are not as sharply defined. (5) A typical "cholesteatoma cavity" can be present with no cholesteatoma found at surgery (evacuated spontaneously or liquefied by infection). (6) Growth usually is expansive. In rare cases growth is infiltrative, in which event, no diagnosis is possible, since signs of pressure erosion are absent. (7) If accompanying infection causes an osteitis of adjacent bone, the otherwise sharply defined walls can become blurred, masking typical signs. (8) A cholesteatoma does not absorb x-rays well enough to become visible inside the cavity as a density. (9) Attempted instillation of a contrast medium into the lesion through the external auditory meatus did not prove of diagnostic value. (10) Where routine examination fails to render definite information, planigraphy can be of value. Findings can, however, be misleading.

In the surgically proved group of 132 cholesteatomas, the lesion was always found at operation in the antrum, aditus ad antrum, and/or attic (recessus epitympanicus), sometimes with extension from these localizations. These three regions were considered individually, and extensive data are presented correlating the radiologic and surgical findings. (There was a single instance of cholesteatoma localized to the external auditory canal.) In 70 of 131 temporal bones the lesion involved all three locations. A roentgen diagnosis of cholesteatoma for one or more of these areas was possible in 68 cases, or 97 per cent. Twenty-nine lesions were confined to the antrum, with correct diagnosis in 83 per cent. The highest incidence of diagnostic failure was in lesions of the attic alone (5 negative diagnoses in 16 cases). The remaining cases were in the aditus, alone or in combination with the aforementioned groups, with a majority of the small lesions in these groups. The rule is that the larger the cholesteatoma, the greater the possibility of correct roentgen identification, with a definite diagnosis made in three-fourths of the large cholesteatomas, and only one-half of the medium and small lesions considered together.

Projections employed over the ten-year period of study varied, and included the Runström I, II, and III, Schüller, Mayer, Stenvers, fronto-occipital, and submento-vertical views. Stereoscopy is used whenever possible, particularly for the Runström II projection. While the antrum is often a plainly visible cavity on many projections, this is not equally true of the aditus and attic. For these latter areas, the Runström II projection with 35° cranial angulation is considered most useful. With the Mayer view, the aditus often is well defined. Marked erosion in the attic and posterior auditory canal usually can be demonstrated, but small erosions are poorly shown.

The size and shape of the antrum in the fronto-occipital projection can be of great value. Measurements and conclusions conform well with previous investigations. The maximum values are 11 mm. in the vertical, and 6 mm. in the horizontal diameter, with the width measured at the junction of the middle and lower thirds, the antrum generally being cone-shaped and pointed toward the aditus. With but one exception, the width exceeded 6 mm. only in the presence of cholesteatoma.

Of 131 cases of surgically proved cholesteatoma, review of roentgen findings revealed either definite or possible cholesteatoma in 91 per cent. In only 9 per cent of the series was no lesion demonstrated. Diagnosis by x-ray proved more reliable when cholesteatoma scales had been found. That the roentgen diagnosis does not always accord with the clinical is explained by the lack of parallelism between the presence of scales in the aural discharge and the size of the cholesteatoma. Thus the roentgen diagnosis depends in greater measure than the clinical on the size of the cholesteatoma.

In 45 temporal bones exploration for cholesteatoma was negative. In only 1 of these were the roentgen criteria positive, but in an additional 17 cases cholesteatoma was suggested. Experience proved that, when doubt existed as to the presence of a lesion, the more indistinct the cavity borders, the less was the possibility of cholesteatoma—within certain limits of size. It was concluded that roentgen examination provided less accurate information in chronic otitis media without cholesteatoma than in cases in which cholesteatoma was present.

Twenty-three patients previously operated upon required reoperation. Alteration in size and shape of a previous surgical cavity is claimed to be the most reliable indication of cholesteatoma in this group. Findings were suspicious in several instances, but in no case was the roentgen diagnosis definite.

Little is known about the rate of growth of cholesteatoma, which is assumed to be dependent on the structure of the surrounding bone, and slower in sclerotic than in pneumatized bone. Definite expansive growth was demonstrated in only 1 of 6 cases in which

roentgenograms made at least two years prior to operation were available.

Granulation tissue mixed with crystals of cholesterol may show erosive changes indistinguishable from cholesteatoma. A small group of such "cholesterol granulomas" is discussed.

Included in this detailed monograph are 41 case reports, with roentgenograms in two or more projections for most cases.

One hundred and twenty-two roentgenograms; 6 drawings; 35 tables. C. M. GREENWALD, M.D.
Cleveland Clinic

THE CHEST

Bronchography with Brief Pentothal-Lysthenon (Succinylcholinchlorid) Anesthesia. A. Leb. Fortschr. a. d. Geb. d. Röntgenstrahlen **81**: 119–126, August 1954. (In German)

Two difficulties are encountered in conventional bronchography: (*a*) the unreliability and potential danger of local anesthesia, and (*b*) the slow absorption of the viscous agent (carboxylmethyl-cellulose) which is added to water-soluble media. The author has used Pentothal-Lysthenon anesthesia during the past three years and has examined between 400 and 500 cases, with superior results and no untoward effect. Lysthenon is used as a muscle-relaxing agent for its rapid action and the short duration of its effect. Curare preparations are longer acting and may require a counteracting drug on completion of the study.

One hour before bronchography, 0.05 gm. of Largactil is injected, to diminish oxygen requirements temporarily, and 0.05 gm. of Phenergan as an antihistaminic. Half an hour later 0.005 gm. of atropine and 10 drops of Ticarda (or other codein-like preparation) are given. Eight to 10 c.c. of 5 per cent Pentothal solution is injected and, after the patient is asleep, 50 mg. of Lysthenon is added. A tracheal tube is then put in place. If there is difficulty with intubation, an oxygen mask may be used for a few moments until the relaxing effect of the Lysthenon has taken place. A No. 34 to 36 tracheal catheter is used, and through this a Metras catheter is gently inserted. This requires about half a minute, and during the procedure breath is suspended, oxygen being supplied by the tube. The end of the tracheal tube lies 1 to 2 cm. above the bifurcation. The Metras catheter is inserted into the main bronchial divisions and directed toward the segment to be investigated. The finer divisions are injected first and, by withdrawal of the catheter, the entire side may be filled. The table is tipped and the patient rotated under fluoroscopic control until the desired distribution is obtained. Often, by simply turning the patient on the opposite side, the other bronchial tree may be filled.

After films are made, the bulk of the contrast material is aspirated. It is important to accomplish this before spontaneous respiration commences, to avoid sucking of the contrast material into the alveoli.

A relatively thin contrast material is advisable. The author uses Joduron B, warmed to body temperature and thinned with one-half volume of water or physiological saline solution.

A well coordinated team and meticulous technic are absolutely essential. The entire procedure should not require more than five or six minutes.

The following advantages are listed by the author.

1. The danger and unreliability of local anesthesia are avoided.
2. With immediate aspiration, it is possible to visualize all branches of one or both lungs and avoid any obstruction within the respiratory tract.
3. Survey of the entire bronchial tree clarifies the relationship of pathological processes to their surroundings.
4. With complete filling of the bronchial branches, early organic changes may be visualized.
5. Mental discomfort of the patient is eliminated.

Five roentgenograms; 1 photograph.
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Congenital Laryngeal Stridor. A Diagnostic Study Including Technique of Tracheobronchography in Infants. Daniel C. Baker, Jr. Arch. Otolaryng. **60**: 172–185, August 1954.

Eighty-three cases of congenital laryngeal stridor are reviewed. Stridor appears at or soon after birth and usually disappears during the second year of life. The infant is usually in good health and seems to suffer no discomfort. The sound of the stridor varies; it may have a soft purring quality, or it can be a croaking noise. Different degrees of respiratory obstruction occur, as manifested by retraction of the thorax and epigastrium. Obstruction may be absent; infrequently it can be quite marked. In 3 cases in the present series tracheotomy was necessary for its relief.

Direct laryngoscopy is the most valuable aid in the diagnosis of congenital laryngeal stridor. The epiglottis is usually of an exaggerated infantile type. It has been called "omega-shaped." It is long, and its lateral margins are folded backward, causing an approximation of the aryepiglottic folds. On inspiration, the entrance to the larynx is greatly reduced. The noise is produced by vibration of the loose connective tissue of the aryepiglottic folds and the loose tissue over the arytenoids, which are sucked inward on inspiration.

The differential diagnosis between congenital stridor and stridor due to a vascular ring may offer a difficult problem to the otolaryngologist. When chronic stridor is accompanied by paroxysms of obstructive dyspnea, cyanosis, and dysphagia, and when feeding brings on these symptoms or increases them, a constricting vascular ring should be suspected.

An enlarged thymus should not be accepted as the cause of stridor on roentgen evidence only. In 5 of the author's cases, stridor was attributed to an enlarged thymus, and x-ray therapy was administered without benefit. Subsequent direct laryngoscopy conclusively established the cause of the noisy breathing to be congenital laryngeal stridor.

Tracheobronchography can be of great value in the differential diagnosis of this type of stridor and should be used wherever direct laryngoscopy does not reveal an obvious lesion or anomaly above the vocal cords.

The author describes his technic of tracheobronchography, which has the advantages of simplicity and freedom from complications. Two cases are reported.

Six roentgenograms.

The Role of Bronchography in Pulmonary Tuberculosis. K. M. Shaw, D. M. Collins, and J. MacNamara. Am. Rev. Tuberc. **70**: 274–284, August 1954.

With the advent of antimicrobial therapy for tuber-

culosis and the widespread use of excisional surgery, bronchography has become increasingly important. Control of the infection with the various new agents has made introduction of material containing iodine less hazardous than in former years, and segmental definition of the disease is important in its presurgical evaluation.

Satisfactory bronchograms obtained in 100 of 113 patients were examined. In only 1 was spread of the disease noted following bronchography. In this instance a large tuberculous cavity was outlined with the contrast material and the disease was bilateral, widespread, and active.

Bronchographic changes were classified as follows:

Grade 1: (*a*) beading of peripheral bronchi, (*b*) slight distortion progressing to crowding, (*c*) occlusion of peripheral bronchi.

Grade 2: (*a*) irregular dilatation of peripheral and intermediate bronchi, (*b*) moderate to severe distortion and crowding, (*c*) occlusion of bronchi at level of second and third divisions.

Grade 3: (*a*) Gross saccular bronchiectasis, (*b*) gross crowding, (*c*) occlusion of bronchi up to segmental orifice.

In 77 cases, new information of value in surgical assessment was obtained; in 19 confirmatory evidence was gained, and in 4 the findings were misleading. New information consisted of anatomic localization which had not been possible with other methods of examination, discovery of unsuspected areas of bronchial damage, and demonstration of healthy segments in areas which had been suspect.

Anatomic correlation was obtained in this study, but pathologic correlation was not attempted because of the extensive study of the specimens necessary for that purpose. The bronchial changes demonstrated are not necessarily typical of tuberculosis, but the location was usually that in which tuberculous disease was known to be present, so that the changes were interpreted as being the result of tuberculosis. In only 4 of the cases was disease found in segments which showed normal bronchi.

The value of bronchography lies chiefly in definition of segmental localization of disease, particularly in suspected paramediastinal collapse, distortion of lung associated with pleural disease, and in those instances where isolated disease lies close to a fissure. The procedure is recommended in all cases of pulmonary tuberculosis when segmental resection is contemplated and precise anatomic localization is lacking.

Ten roentgenograms; 4 tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Radiologic Manifestations of Bronchial Obstruction in the Course of Primary Tuberculosis. Giulio de Giuli. Radiol. med. (Milan) **40:** 625-637, July 1954. (In Italian)

The impossibility of producing atelectasis, and especially emphysema, in the normal lung by complete or incomplete obstruction of a minor branch of a lobar bronchus has been demonstrated experimentally. This has been explained by the presence of interalveolar pores permitting the interchange of air with surrounding tissue. A morbid parenchymatous process prevents such gaseous interchange.

Atelectasis and emphysema, common during primary tuberculosis, are in many cases clinically silent. Even when symptoms are present, a clinical diagnosis is difficult. Radiologic study of these phenomena surpasses even gross anatomic observations.

Several cases are presented with serial roentgenograms demonstrating the course of atelectasis and emphysema in primary tuberculosis. While most often the radiologic interpretation of the shadows is clear, at times the diagnosis of atelectasis can be established only by the presence of pendulum movements of the mediastinum, hyperinflation about the opacities, and above all the evolution of the radiologic picture, with relatively rapid appearance and disappearance of extensive opacities and the alternation of such areas with hyperinflation. The good condition of the patient belies the extensive opacification.

Emphysema often goes unnoticed because its occurrence in primary tuberculosis is so little known and its radiologic appearance is not as striking as that of atelectasis. Small foci of obstructive emphysema may be present in the center or margins of glandular and parenchymal opacities and also at some distance from them. These areas are of irregular form, usually with sharp margins, and may be either single or multiple. They are better demonstrated in forced expiration. They are often interpreted as cavities, but true cavities are rare in primary tuberculosis. Again, study of the movements of the diaphragm and mediastinum and serial roentgenograms will clarify the diagnosis. Emphysema involving the entire lung may be so marked as to be confused with spontaneous pneumothorax. In the more typical cases a single lobe is involved, most often the right middle, because of the peculiarities of its bronchus. Emphysema may be so marked as to conceal the hilar lymphadenopathy by displacing it into the mediastinal shadow; this mass may be seen on the lateral projection.

Rupture of the visceral pleura with formation of a pneumothorax is an infrequent complication in primary tuberculosis because of the elasticity of the pleura in children, but it does happen. Similarly, rupture of an alveolar wall with formation of mediastinal emphysema can occur.

Obstructive emphysema and atelectasis are particularly favored in childhood because of the relative and absolute caliber of the bronchial tree. Obstruction of the small bronchi is due primarily to inflammatory swelling of the mucosa and accumulation of secretions. The obstructive phenomena are local. The larger bronchi, on the other hand, owe their obstruction to the surrounding lymph nodes, either by direct compression or direct extension of the inflammatory process from the nodes into the bronchial wall and lumen. The recently increased use of bronchoscopy in children has demonstrated the actual process, and its frequency. For example, 46 of 126 children with hilar lymphadenopathy in primary tuberculosis were shown to have such bronchial involvement by bronchoscopy. The obstruction was produced, at least in part, by the caseous material in the bronchial lumen, and aspiration led to a reduction or disappearance of the obliterative changes.

The author pleads for use of skilled bronchoscopy both diagnostically and therapeutically (aspiration) in those cases with protracted obstructive phenomena, in order to prevent serious permanent complications such as bronchiectasis.

Twenty-three roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

The Course of Pulmonary Tuberculosis During Long-Term Single-Drug (Isoniazid) Therapy. Kurt Deuschle, Louise Ormond, DuMont Elmendorf, Jr., Carl Muschenheim, and Walsh McDermott. With technical assistance of Kurt Stern. Am. Rev. Tuberc. **70**: 228–265, August 1954.

The ease with which Isoniazid-resistant organisms can be found in sputa of tuberculous patients after therapy with the drug, as well as in patients who have not been treated, has led many investigators to feel that Isoniazid should be used only for short-term treatment or in conjunction with other agents. The present study was undertaken to determine the validity of this view. Observations were made on 47 patients, of whom 32 completed a year of Isoniazid therapy. Twenty-one of this latter group showed substantial roentgenographic improvement. All cavities closed in 12, which was about one-third of all patients with cavitation. Three-fourths of the group became sputum- and gastric-negative during the year of treatment, but there was no particular correlation between the microbiologic and roentgenographic findings. Six patients became roentgenographically worse.

The principal significance of this study is that the majority of patients started on Isoniazid alone remained on it because there was no compelling indication for a change. There appears to be enough evidence to conclude that the period of usefulness of Isoniazid as a single agent is longer than has previously been generally accepted. The problem of the choice of drug therapy in various types of pulmonary tuberculosis is discussed at length. Roentgenograms of the 6 patients who showed evidence of change felt to indicate worsening of the disease are shown.

Twenty-one roentgenograms; 2 tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Segmental Resection for Pulmonary Tuberculosis. Alfred Goldman, Fred Preuss, William Gyarfas, Jerome Abrahams, Ben Rosner, and A. E. T. Rogers. Am. Rev. Tuberc. **70**: 285–295, August 1954.

In a study of 70 consecutive patients with pulmonary tuberculosis who underwent segmental or multiple segmental resection, a considerable number of relatively minor complications occurred, but there were only 2 postoperative deaths; a third death from tuberculous meningitis occurred five months after surgery. Correlation of roentgenographic and pathologic findings was only moderately good, with 13 cavities and 5 poorly localized and/or unencapsulated caseous foci not detected roentgenographically. Correlation in the case of encapsulated caseous foci was very good.

Serial roentgen examination with planigrams is an important guide for determination of most lesions amenable to segmental resection. Bronchography with a rapidly eliminated contrast medium should probably be used more widely to delineate bronchiectasis and extent of disease.

Of interest is the fact that in the group of patients non-infectious preoperatively, examination of the surgical specimens revealed acid-fast bacilli in 23 per cent and culture revealed tubercle bacilli in 8 per cent. In the infectious patients, the resected specimens were smear-positive in 36 per cent and positive by culture in 13 per cent.

It is concluded that further study is needed to determine whether or not patients undergoing segmental resection will remain sputum-negative and to determine the length of time for administration of antimicrobial drugs pre- and postsurgically.

Two planigrams; 2 photographs; 7 tables.

JOHN H. JUHL, M.D.
University of Wisconsin

The Pulmonary Tuberculoma in Childhood: Its Medical and Surgical Management. Karl E. Kassowitz. J. Pediat. **45**: 153–163, August 1954.

Tuberculoma, in the broad sense of a well defined area of tuberculous granulomatous tissue, is classified as follows: (*a*) minute peripheral primary tuberculoma, tending to heal with or without roentgenographic residuals; (*b*) primary or postprimary pneumonic type, tending to heal with fibrocalcific nodular residuals; (*c*) reinfection "coin lesions"; (*d*) cavitary lesions, rare in children.

The chief difference between childhood tuberculosis and adult tuberculosis is the tracheobronchial lymphadenitis associated with the former. It is this bipolar nature of childhood tuberculosis which defeats the surgical approach: the value of surgery lies in the limited resection of an extensive or potentially dangerous focus of disease, and in childhood tuberculosis, with active lymph node involvement, it is not possible to remove all important foci except by total pneumonectomy. On this basis, the validity of surgery is questioned in the first three categories and it is held that only in exceptional instances of proved cavitary lesions should resection be considered alongside conservative methods of treatment. It is concluded that proper identification and classification will lead to a therapeutic program which, as a rule, will be successful without surgery.

Eleven cases are reported as examples.

Twenty-four roentgenograms

H. G. PETERSON, JR., M.D.
New Britain, Conn.

Disseminated Bullous Emphysema After Spontaneously Healed Miliary Tuberculosis; Death by Progressive Respiratory Insufficiency. J. Brun, J. Viallier, L. F. Perrin, and P. Juttin. J. franç. de méd. et chir. thorac. **8**: 525–532, 1954. (In French)

A 23-year-old male presented himself with disseminated miliary pulmonary densities in 1945. The cutaneous tuberculin reaction was strongly positive, and blood studies revealed tubercle bacilli in pure culture. The patient received no chemotherapy, being treated chiefly by rest. From 1946 to 1949 the pulmonary shadows decreased in size, but signs and symptoms of pulmonary insufficiency gradually developed. As the miliary densities disappeared, it was noted that both hemidiaphragms became less mobile. Blood oxygen saturation decreased to 74 per cent and venous pressure was elevated to 25 cm. water. On Feb. 26, 1953, an electrocardiogram revealed signs of chronic cor pulmonale. The patient's disability increased and he became intensely cyanotic. He died on Feb. 2, 1954, nine years after the episode of miliary tuberculosis.

At autopsy the lungs presented the gross appearance of emphysema. The vascular and bronchial systems were injected with plastic material. There was a general hypovascularity of the pulmonary tissue. The injection of the bronchial tree revealed no obstruction even in the smallest bronchial branches. Rather, there was filling of multiple alveolar neo-cavities. Histologic

study revealed bands of sclerotic collagenous tissue which appeared to separate small bronchioles from the dilated alveolar neo-cavities.

Two roentgenograms; 2 photomicrographs; 1 photograph.

CHARLES M. NICE, JR., M.D.
University of Minnesota

Routine Chest X-rays of All Patients Admitted to General Hospitals. Chronic Disease and Tuberculosis Program of the Division of Special Health Services, Public Health Service. Pub. Health Rep. **69:** 569–570, June 1954.

The practice of obtaining routine hospital admission chest films has been greatly stimulated by studies of the National Tuberculosis Association and the U.S. Public Health Service. It has been clearly demonstrated that such films afford a high yield of previously unsuspected cases of tuberculosis of the reinfection type. One survey of 214,815 chests revealed 3.58 cases of tuberculosis per thousand, as well as 4.59 suspected cases, and 110.4 cases of other chest lesions. In New York, 80 per cent of the cases of tuberculosis detected by hospital admission surveys were previously unsuspected.

Hospitals with facilities for admission films frequently do not survey all admissions, often omitting obstetrical cases, emergency admissions, and patients who have recently had a chest film.

Nearly 50 per cent of the hospitals of 250 or more beds in the United States have facilities for routine admission films, but in no state do a majority of hospitals have such facilities. In only 4 states do more than a third of the hospitals provide this service, and in 6 states, less than 10 per cent do so. It appears, therefore, that further promotion is indicated.

Two tables.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Admissions to General Hospitals. Sydney Jacobs and Arthur A. Calix. Am. Rev. Tuberc. **70:** 304–311, August 1954.

The findings on 70-mm. chest films taken on 428,254 patients seen at Charity Hospital of Louisiana at New Orleans were studied. Tuberculosis was found in 4.4 patients per 1,000 whose disease probably would not have been discovered otherwise until much later in the course. This was the yield despite the fact that approximately 7,000 suspects eluded follow-up procedures. Approximately 5 per cent of the group had non-tuberculous disease; 3.7 per cent were found to have some cardiovascular abnormality. The cost of this survey was estimated at $110 for each unsuspected case of active pulmonary tuberculosis discovered. This same expenditure also covers discovery of 4 previously undetected instances of cardiac disease and a number of non-tuberculous pulmonary diseases.

The survey indicated, as have many others, that in order to protect the investment in case finding, expenditures for follow-up must be increased. A higher incidence of tuberculosis was found in the sick population entering the hospital and going through its out-patient department than in the general population. Examination of hospital admissions is felt to be a good method of case finding for tuberculous and non-tuberculous chest disease.

Two illustrations.

JOHN H. JUHL, M.D.
University of Wisconsin

Tuberculosis Resurveys of Patients in California Mental Institutions. Waldo R. Oechsli. Pub. Health Rep. **69:** 560–568, June 1954.

Surveys indicate that mental hospitals are probably the largest remaining reservoirs of tuberculosis. In California at least, when a patient has recovered from his mental disorder sufficiently to be discharged, he cannot be detained longer for treatment of his tuberculosis, even though the disease is active. He thus becomes a public menace.

The author suggests combating this situation by an immediate survey of present mental patients followed by yearly resurveys by means of chest films. Tuberculous suspects should be studied promptly by laboratory and clinical means. Those with active or potentially active disease should be segregated. Patients with inactive disease should be observed carefully for reactivation, as such cases have been known to result in so-called acute epidemics of tuberculosis in mental institutions.

The authors recommend that all tuberculous mental patients be placed in one hospital for simultaneous treatment of both the tuberculosis and the mental condition. New patients in mental institutions should have admission chest films and, if found to be tuberculous, should be sent to the segregation center. A modified contagious disease technic should be employed in the care of active cases. Employees should have chest films every three months.

The first case finding program in California mental institutions was carried out in 1934, and by 1946 a continuing annual program was begun. An initial survey at that time (Pub. Health Rep. **64:** 4, 1949. Abst. in Radiology **53:** 887, 1949) revealed an incidence of 8.25 per cent previously unrecognized cases of reinfection type in the mentally ill, and 1.2 per cent in the mentally deficient. After the régime outlined above had been instituted, resurveys showed a steady decrease to 0.37 per cent for the mentally ill and 0.17 per cent for the mentally deficient. The rate for employees dropped from 1.4 per cent to 0.05 per cent. The decline in the death rate from tuberculosis in mental institutions has shown comparable decrease, from 800 per 100,000 in 1946 to 482 in 1950 and 361 in 1951.

Six tables.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Non-Tuberculous Cavities in the Lung. James J. Waring. Minnesota Med. **37:** 565–576, August 1954.

Certain non-tuberculous causes of lung cavitation are discussed, particularly from the standpoint of differentiation from tuberculosis. All are illustrated by case reports and roentgenograms, with the exception of histoplasmosis.

Friedländer's Pneumonia: Friedländer's pneumonia has a predilection for elderly, diabetic, and alcoholic patients. Abscesses develop in about 60 per cent of the cases. Persistent thin-walled cavities, with metastatic lesions elsewhere in the lungs, simulate chronic pulmonary tuberculosis, but the sputum is consistently negative for tubercle bacilli. In more than half the cases blood cultures are positive for Friedländer's bacillus.

Coccidioidomycosis: The usual case of coccidioidomycosis with cavitation is asymptomatic, although hemoptysis may occur. A history of exposure in an endemic area is important. Chronic progressive dissemination, which has a 50 per cent mortality, occurs in a few cases, but has not been reported to follow acciden-

tal discovery of a cavity in an asymptomatic patient. A positive skin test is significant. In questionable cases, simultaneous testing should be done for coccidioidomycosis, histoplasmosis, and blastomycosis, the strongest response being read as the positive one. Surgery is indicated if the cavity becomes enlarged, infected, or ruptured, if hemoptysis is repeated and severe, and for coccidioma formation.

Histoplasmosis: Cavitation is uncommon in histoplasmosis but can occur. Radiologically this disease resembles tuberculosis greatly; it must be differentiated by bacteriological study and skin tests.

Paragonimiasis: This type of pulmonary abscess is produced by the lung fluke, which migrates through the diaphragm into the lung. The patient is usually in good condition, with intermittent hemoptysis from a basal cavity. There is always a history of exposure in an endemic area (Korea or Japan), and the ova can be found in the sputum.

Actinomycosis: Fifteen per cent of cases of actinomycosis show chest involvement. The chief characteristic of the disease is its disregard for normal tissue planes and barriers. It will penetrate the diaphragm, pleura, and even the chest wall. It is a very chronic infection, diagnosed by microscopic demonstration of the organism in the sputum or pus from a draining sinus. Some of the the newer broad spectrum antibiotics are helpful in treatment.

Hodgkin's disease: The lungs are involved in 15 to 40 per cent of patients with Hodgkin's disease, but cavitation is not common. Peripheral, abdominal, or mediastinal lymph node masses should lead to a biopsy diagnosis long before a pulmonary mass grows large enough to cavitate.

Carcinoma: Primary bronchial cancer often obstructs a bronchus, causing a suppurative pneumonitis. The cavity is often eccentric, and rib erosion may be present. Bronchoscopy and biopsy will establish the diagnosis. Very rarely metastatic carcinoma may break down and form a cavity.

A note is included on basal tuberculous cavities, which may be confused with some of the non-tuberculous cavities and result in dangerous exposure to hospital personnel unless all cases are considered possibly contagious until proved otherwise.

In the conclusion the author mentions simple abscess from aspiration and septic infarction as lesions to be differentiated from the other entities illustrated but does not discuss them further or give any examples.

Sixteen roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Some Anatomo-Clinical Aspects of Pleuropulmonary Staphylococcal Infections of the Newborn. Mme. Pichot-Janton, Y. Coutel, and Ch. Jezequel. J. franç. de méd. et chir. thorac. **8:** 533–545, 1954. (In French)

Staphylococci may enter the body through the skin to be transported by the blood to the lungs, or may enter the pharynx and be carried to the lungs *via* the tracheobronchial pathway. Abscesses or bullous lesions develop in the lungs. A secondary purulent pleurisy may occur, or one of the bullous lesions may rupture, leading to a pyopneumothorax. At times a suffocating pneumothorax may develop, which constitutes a therapeutic emergency.

Therapy is conditioned by the type of lesion. The pneumonic process with bullous cavities may respond to antibiotic therapy. Development of empyema or pyopneumothorax necessitates surgical drainage.

Thirty-three roentgenograms.

CHARLES M. NICE, JR., M.D.
University of Minnesota

Diagnostic Aids in Histoplasmosis. R. S. Gass and L. D. Zeidberg. Am. Rev. Tuberc. **70:** 360–362, August 1954.

A case is reported in which a chest roentgenogram revealed a diffuse nodular type of infiltration in both lung fields two weeks following the onset of malaise, fever, and night sweats. Sputum smears and cultures were negative for tubercle bacilli and *H. capsulatum* on two occasions, and the tuberculin test was negative. The histoplasmin skin test changed from negative to positive within two months and there was evidence of an increase in and then a waning of the immunologic response as manifested by precipitin and complement-fixation tests. The chest findings cleared without residuals in five months. *Histoplasma capsulatum* was isolated from the soil of a chicken house which the patient had cleaned three days before the onset of the illness. These findings are believed to be sufficient to indicate definite histoplasmosis despite the failure to isolate the organism from the sputum. Recovery was spontaneous with symptomatic treatment.

Three roentgenograms. JOHN H. JUHL, M.D.
University of Wisconsin

Paragonimiasis of the Lung (Lung Fluke). C. Vojtek. Acta radiol. & cancerol. bohemoslov. **8:** 132–135, May 1954. (In Czechoslovakian)

Paragonimiasis (infestation by the lung fluke) has been unknown in Czechoslovakia, but the author observed a case among the numerous Koreans now residing there. The patient, a 12-year-old boy, presented the typical roentgenographic triad: infiltrative lesions up to 2 cm. in diameter, cysts developing rapidly in the original infiltration, and bronchiectasis with involvement of a pulmonary segment. For the differential diagnosis the finding of *Paragonimus westermani* (*Distoma pulmonale*) in the sputum is of decisive importance. Tuberculous infection is especially to be excluded.

Seven roentgenograms E. A. SCHMIDT, M.D.
Denver, Colo.

Bronchogenic Carcinoma. A Study of 517 Cases. Adrian Ehler, Allan Stranahan, and Kenneth B. Olson. New England J. Med. **251:** 207–213, Aug. 5, 1954.

The authors review 517 cases of bronchogenic carcinoma seen at Albany (N.Y.) Hospital from 1936 to 1951. Forty cases were seen in the period 1937–41, and 320 cases in the period 1947–51, an increase of 700 per cent. Ninety-three per cent of the series were males, with the lowest male/female ratio seen in the group with adenocarcinoma (2.7:1). Only 13 patients were under forty years of age, the youngest being twenty-eight years. The commonest site of origin was in the upper lobes, the right side predominating.

The initial and other symptoms are tabulated. Squamous-cell carcinoma appeared more likely to cause bronchial symptoms initially than any of the other types. In some 40 per cent of the total group the earliest symptoms were extrabronchial, as hoarseness, pain, or dysphagia, indicative of spread beyond the

lung, which would suggest that neither lay nor medical education can contribute much toward earlier diagnosis. Routine x-ray examination disclosed only 8 cases or 1.6 per cent of the total in this series, a depressingly low figure considering the large number of x-ray surveys conducted in New York State. Furthermore, a review of the initial roentgenograms showed that 25 patients (4.9 per cent) had a normal postero-anterior chest film at the time of diagnosis.

Seventy per cent of the cases were advanced to such a degree that definitive surgery was contraindicated, leaving only 30 per cent operable. This is somewhat at variance with the 50 per cent operability rate reported by some of the larger thoracic surgery clinics. The authors believe that their figure is more representative of the overall problem, perhaps indicating that many patients with obvious metastasis or who are poor surgical risks were never sent to the special clinics for evaluation for thoracic surgery. Approximately one-half of the operable lesions were resectable, except for anaplastic carcinoma, which had a 38 per cent resectability.

Only 15.4 per cent of patients survived for a year or more after diagnosis; 10.6 per cent of those without resection survived for at least a year, and 52.5 per cent of those with resection were alive a year or more after operation.

Among 220 cases which could be followed five years, there were 5 (2.3 per cent) five-year survivals. Three had squamous-cell carcinoma and 2 had adenocarcinoma. No patient with known lymph node metastases at the time of surgery survived for five years.

The authors believe that the histologic and biologic characteristics of these tumors are probably more important in prognosis than is early diagnosis. It is only in the biologically more favorable lesions that one can expect to improve the survival rate by earlier diagnosis, including use of cytologic sputum studies, and more prompt surgical treatment.

Two graphs; 1 drawing; 8 tables.

C. M. GREENWALD, M.D.
Cleveland Clinic

Tomography in the X-ray Diagnosis of Bronchial Carcinoma. W. Brauer and K.-H. Ficke. Fortschr. a. d. Geb. d. Röntgenstrahlen **81:** 127–130, August 1954. (In German)

The value of tomography in identifying bronchial carcinoma has not, to date, been fully recognized. In many cases, by this simple procedure, the necessity of bronchography or bronchoscopy may be eliminated; in other cases confirmatory evidence is obtained, especially in centrally located lesions. The potentially harmful result of anesthesia, the effect of viscous material incident to bronchography, and the discomfort to the patient are thus completely avoided.

The author has followed 149 cases from Jan. 1, 1951, to June 30, 1953. Histologic findings, operating room specimens, or autopsy material were available in 115 of these, and 19 were diagnosed clinically. Errors in diagnosis were established in 12. Two cases diagnosed as tuberculosis later proved to be tumor. In 1 case carcinoma was diagnosed but biopsy showed tuberculosis. In other instances, the middle lobe syndrome and chronic pneumonic and other non-specific infiltrative conditions were confusing. Of the 146 cases, 17 were also studied by bronchography, and in only 5 of these were findings of additional significance obtained. Of the 115 proved cases, 110 gave a clean-cut tomographic diagnosis in full agreement with the operative or autopsy findings.

It was found that mass lesions could be identified by tomography at a very early stage, and in most cases could be differentiated from the associated atelectasis and surrounding infiltration. Narrowing of the bronchial lumen was an early sign. Infiltration of the lumen was found with a remarkable degree of regularity in these lesions. Peripheral masses were more confusing.

The author believes that tomography can show a lesion as early as bronchography and should be performed before the latter procedure, especially in the presence of suspicious central mass lesions.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Cardio-Pericardial Metastases from Cancer of the Lung (Pathologico-Radiologic Correlation in 32 Cases). Luigi Vespignani. Radiol. med. (Milan) **40:** 665–691, July 1954. (In Italian)

Among 210 primary cancers of the lung examined between 1942 and 1952, one-sixth had cardio-pericardial metastases. The author compared the pathologic and the radiologic findings in 31 patients in whom autopsy proof of the metastases was obtained. The radiologic examination included standard roentgenograms, at times with tomography and bronchography, and in one case kymography. The cardiac image was normal in 15 cases; in 10 cases it was partially masked by the opacity in the lung or pleural fluid; in 3 cases the heart shadow was generally enlarged (in 1 of these there was massive infiltration of the wall of the heart); the other 2 cases presented a prominence of the middle arch on the left contour of the heart (proved metastasis in the left auricle).

The author emphasizes the importance of generalized or partial cardiac enlargement when radiologic signs indicate or are suggestive of cancer of the lung. He feels that systematic radiologic examination of the heart is important in all patients with this disease, in order to detect the first signs of spread in the heart. This, of course, is important for determining operability and prognosis.

Eleven roentgenograms; 1 photograph; 2 tables.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Hamartoma Simulating Ipsilateral Metastasis in a Case of Primary Bronchogenic Carcinoma. Louis R. Davidson and Seymour H. Stern. Dis. of Chest **26:** 210–216, August 1954.

The authors give the case history of a 71-year-old white male in whom two lesions were observed roentgenographically. One occupied the apical portion of the left upper lobe and was diagnosed as a bronchogenic carcinoma with pneumonitis involving the adjacent lung. The second lesion was described as a "large fibrotic nodule or area of infiltration in the plane of the fourth intercostal space" and was considered to be a metastasis. A pleuro-pneumonectomy was performed. Microscopic examination revealed a well differentiated epidermal carcinoma of the left upper lobe bronchus with atelectasis and acute and chronic inflammation of the peripheral lung parenchyma. The fibrotic nodule which had been thought to be a metastasis proved to be a benign hamartoma.

Hamartomas are benign mixed tumors composed of

normal tissue of the organ involved, arranged in an abnormal way or developed abnormally. They are not infrequently reported as "chondromas." They are usually solitary, slow growing, subpleural, and asymptomatic. They occur with greater frequency in males and may be found at all ages. They may be lobulated, round, or spherical, and are sharply delineated from surrounding tissue. Calcification may be present. Malignant change is rare. Hamartomas are to be differentiated from bronchogenic carcinoma, solitary metastasis, bronchial adenoma, and tuberculoma.

The interest in this case is the fortunate co-existence of the two lesions in one lung; otherwise the patient would have been denied the benefit of surgery.

Three roentgenograms; 2 photomicrographs.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Lipoid Pneumonia Simulating Tumor. Edgar W. Davis, Aubrey O. Hampton, Charles E. Bickham, and Theodore Winship. J. Thoracic Surg. **28:** 212-219, August 1954.

The authors report 6 cases of lipoid pneumonia which simulated lung tumor. All of the patients were operated on, either a pneumonectomy or lobectomy being performed, depending upon the extent of the disease.

The roentgenographic findings in lipoid pneumonia are fibrosis and consolidation. The disease usually involves the right middle and lower lobes and remains unchanged for years. One of the authors' cases involved the right upper lobe. The fibrosis takes the form of linear and small nodular densities which have the appearance of spun glass. The process may extend to the pleural surface, but pleural effusion is rare. With a Bucky film and a fine focus tube, areas of apparent consolidation can be seen to contain air and present the spun-glass appearance.

At operation, hilar and mediastinal lymph nodes were found to be greatly enlarged in 2 of the authors' cases. Grossly all of the lesions were described as firm and rubbery. The diagnosis was made histologically. Lipoid pneumonia was not suspected at the operating table because of the close resemblance to carcinoma.

When sudanophilic material is found in the fibrous tissue some distance from the alveoli, it is considered to be ingested oil. In the alveoli and alveolar walls, it is likely to be due to preoperative iodized oil studies. The disease in the authors' series was caused by mineral oil taken for relief of constipation in 4 instances, by nose drops in 1, and petrolatum in 1. The finding of oil in the phagocytes of the sputum aids in the diagnosis.

Most patients with lipoid pneumonia need no active treatment. Surgery is indicated when the pulmonary lesion cannot be differentiated roentgenologically from a tumor.

Six roentgenograms; 4 photomicrographs in color.

RENE G. FORTIER, M.D.
St. Paul, Minn.

Articular Manifestations in Pulmonary Diseases. An Analysis of Their Occurrence in 1,024 Cases in Which Pulmonary Resection Was Performed. William H. Wierman, O. Theron Clagett, and John R. McDonald. J.A.M.A. **155:** 1459-1463, Aug. 21, 1954.

Among 1,024 consecutive patients undergoing pulmonary resection at the Mayo Clinic, signs of pulmonary osteoarthropathy were found in 61, the incidence being as follows:

Specific lesion	No. of Resections	Osteoarthropathy Present
Malignant tumor	481	25 (5.2%)
Bronchiectasis	189	18 (9.5%)
Pleural mesothelioma	14	8 (57.1%)
Lung abscess	34	6 (17.6%)
Cyst	30	3 (10.0%)
Tuberculosis	157	1 (0.6%)
Miscellaneous benign tumor, granuloma, etc.	119	0
Total	1,024	61 (6.0%)

Findings indicative of osteoarthropathy included objective signs, such as digital clubbing or long bone periosteal proliferation, or both, and arthralgia without objective evidence. Subjective findings alone are more commonly a manifestation of pleural mesothelioma but may also be encountered with malignant pulmonary lesions.

The authors agree with Hansen (Acta med. scandinav. Supplement 266, p. 467, 1952) that clubbing and osteoarthropathy are similar reactions. However, the former is prone to occur in association with diffuse pulmonary disease (*e.g.*, bronchiectasis), and develops and disappears slowly. On the other hand, a periosteal proliferation reaction is more likely with a localized pulmonary lesion such as carcinoma, it affects the larger joints, and it has a more rapid course. Either may precede the other or be independent of the other.

Clubbing of the fingers was the commonest manifestation of pulmonary osteoarthropathy, being seen in 55 of the 61 patients. Usually clubbing was encountered prior to visible involvement of the long bones. In those cases in which clubbing was absent in the presence of arthralgia, the interval between the onset of arthralgia and resection of the thoracic lesion was three months or less, or the arthralgia was mild.

The highest incidence of osteoarthropathy was in the pleural mesothelioma group. Of the 8 patients with symptoms or physical findings, or both, referable to the joints, 6 had an initial and predominant complaint of arthralgia. Clubbing was noted in 5. Osseous roentgenograms were obtained in only 2 of the 8 patients. In 1, films of the ankles were normal; in the other, who had had painful migratory swelling of almost all joints for sixteen years, x-rays showed periosteal proliferation only at the distal ends of the femurs. This latter patient experienced immediate relief from joint pains following removal of a huge mesothelioma from the pleura. Within eighteen months the clubbing of her fingers had completely disappeared.

The next highest frequencies of osteoarthropathy were in lung abscesses, pulmonary cysts, and bronchiectasis. The finding in each instance was clubbing, except for arthralgia encountered in one patient with a congenital pulmonary sequestration. Clubbing was found to develop more rapidly in association with abscess than with bronchiectasis.

Of the patients with suppurative and tuberculous lesions, none complained of arthralgia. Apparently this manifestation is practically always caused by either a pleural mesothelioma or a malignant pulmonary lesion. One patient with a squamous-cell epithelioma of the right lung exhibited clubbing limited to the fingers

of the right hand. Patients with malignant lung tumors frequently obtained dramatic relief of arthralgia immediately after extirpation of the "trigger lesion." If the lesion reappeared, the arthritis was likely to recur.

The authors stress the frequency of pleural involvement in patients who exhibit osteoarthropathy. They suggest that, as the mesothelial cells of the pleura are pluripotential, their stimulation by the lesion may perhaps release some osteoblast-stimulating substance capable of inducing an articular and bony response.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Tracheopathia Osteoplastica. David T. Carr and Arthur M. Olsen. J.A.M.A. **155:** 1563–1565, Aug. 28, 1954.

Tracheopathia osteoplastica is a rare disease of the trachea and bronchi characterized by growths of cartilage and bone within the walls of the trachea or bronchus that produce sessile polyps and plaques that project into the lumen and may partially obstruct it. Clinical manifestations, when present, are cough, expectoration, hemoptysis, and bouts of obstructive pneumonitis. The authors add 7 cases to the 90 previously reported. In 6 of the 7 cases the diagnosis was made on bronchoscopic examination, and in 3 instances on biopsy.

In several of the patients tomograms of the trachea and bronchi revealed shadows suggestive of tracheopathia osteoplastica. Although these films were made, as a rule, after the latter diagnosis had been established, they were of value in studying the extent of the lesions. The nodules do not stand out as clearly in the tomographic image as they do to the bronchoscopist. The tomogram depicts the thickening of the entire tracheal and bronchial wall, the surface of which has a beaded or scalloped appearance. At times a large polyp or an extensive plaque-like appearance produced by coalescence of the nodules is demonstrable. The tomograms also show the extreme narrowing of the trachea that may occur.

Two roentgenograms; 2 photomicrographs; 2 drawings.

Periarteritis Nodosa in a Nine-Month-Old Infant. E. Liban, Z. Shamir, and S. Schorr. Am. J. Dis. Child. **88:** 210–215, August 1954.

The eleventh reported case of periarteritis nodosa occurring in infancy is recorded. Symptoms, present from birth, consisted of progressive failure to gain weight, attacks of fever, vomiting, diarrhea, malnutrition, cyanosis, and dyspnea. The course was protracted to death at nine months of age. A series of chest roentgenograms showed progressive enlargement of the heart and pulmonary vascular shadows, with the eventual development of confluent patchy and hazy shadows through both lung fields. Autopsy revealed healed and healing lesions of periarteritis nodosa involving predominantly the lungs and heart, associated with pulmonary hemorrhage and hemorrhagic infarction. The case is considered unusual because of the pulmonary involvement, said to be uncommon in infants and children, and because of the healed and healing stage of the lesions.

Three roentgenograms; 1 photograph; 3 photomicrographs. H. G. PETERSON, JR., M.D.
New Britain, Conn.

"Spontaneous Pneumo-Mediastinum." Mediastinal Emphysema. N. G. Gadekar. Indian J. Radiol. **8:** 160–167, August 1954.

The author reports 8 cases of mediastinal emphysema, all well advanced, discovered in about 200,000 x-ray examinations. He believes that the incidence of less extensive collections of air in the mediastinum must be considerably higher. Six of the 8 cases occurred in children under eight years of age. Whooping cough is suggested as a probable predisposing cause.

The usual roentgen finding is mentioned, a thin line of increased radiance parallel to the heart border, demonstrable on the postero-anterior film. Lateral and oblique views will show air pocketed between the heart and sternum, as well as in the posterior mediastinum.

Eleven roentgenograms.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Pneumomediastinum in the Newborn: A Report of Three Cases. J. E. Arata and C. G. McEachern. Dis. of Chest **26:** 229–234, August 1954.

The authors give the case histories of three newborn infants in whom a pneumomediastinum was responsible for respiratory distress. In 2, a pneumothorax developed. With recognition and conservative care there was complete recovery in each instance.

Pneumomediastinum in the newborn is most commonly due to congenital defects of the tracheobronchial tree and to excessive intra-alveolar pressure during attempts at resuscitation. With overdistention of the alveoli, rupture occurs, and air is forced along the extra-alveolar pulmonary vessels to the root of the lung. These vessels, being extrapleural, offer a direct pathway to the anterior mediastinum. If the pressure in the mediastinum is great enough, it will rupture the mediastinal pleura and produce a pneumothorax.

Pneumomediastinum is strongly suggested by the presence of a crackling sound in the mediastinum. A lateral chest film will establish the diagnosis.

Eight roentgenograms.

HENRY K. TAYLOR, M.D.
New York, N. Y.

THE CARDIOVASCULAR SYSTEM

The Selection of Patients for Mitral Valvotomy. Allan Wynn. M. J. Australia **1:** 885–891, June 12, 1954.

The selection of patients for mitral valvulotomy to relieve mitral stenosis depends upon clinical, roentgenologic, and electrocardiographic findings. Symptoms such as lassitude, dyspnea, and orthopnea give some indication of the general condition of the patient but are of little value in assessment of the lesion. Massive hemoptysis nearly always denotes moderate to severe mitral stenosis, as do recurrent attacks of bronchitis.

Occasionally patients with severe mitral stenosis have few or no symptoms until some added factor occurs to tip the scales, as an infection, pregnancy, anemia, thyrotoxicosis, arrhythmia, or systemic or pulmonary embolism. In such cases evaluation of severity is difficult and depends largely on the physical signs. In general, patients in whom all the elements of the auscultatory rhythm of Duroziez are present (a sharp first sound, no systolic murmur, an "opening snap," and a long rumbling mid-diastolic murmur), and who also have evidence of right ventricular enlargement, are

likely to prove suitable for operation. They are unlikely to have grossly calcified valve cusps, significant mitral incompetence, or other serious valve lesions.

After clinical examination, fluoroscopy is the most useful means of evaluating patients for mitral valvulotomy. In general, the larger the heart, the more severe the disease and the worse the prognosis. There are, however, important exceptions, since the heart may be of almost normal size in severe mitral stenosis. The size of the left auricle shows no correlation with the hemodynamic or operative findings. Presumably, auricular dilatation is due to myocarditis rather than simple increased pressure from mitral stenosis. Enlargement of the pulmonary artery and right ventricle correlate closely with the degree of stenosis. Assessment of the size of the left ventricle by fluoroscopy is readily made in those few cases of rheumatic heart disease in which there is little or no associated right ventricular enlargement—for example, pure mitral incompetence or lone aortic valvular lesions. When the right ventricle is also enlarged, it is virtually impossible to determine the size of the former chamber radiologically, because the left ventricle is rotated posteriorly by the enlarged right ventricle, which causes it to appear more prominent in the left anterior oblique view.

The detection of pulmonary congestion or edema by fluoroscopy usually denotes severe mitral stenosis, but its absence does not exclude this diagnosis.

The presence of hemosiderosis has not been found to correlate with any clinical or hemodynamic features of mitral stenosis, nor has the presence of gross calcification of the mitral valve, although significant mitral incompetence is more common in these patients.

If mitral stenosis is present, it may be impossible to assess the presence or degree of mitral incompetence. The best sign is a forceful left ventricular apex beat in the absence of aortic valve disease or hypertension. But this may be absent if the left ventricle is rotated posteriorly by an enlarged right ventricle. Resort can then be had to fluoroscopy and electrocardiography, the limitations of these procedures being borne in mind. Until better methods of diagnosis are evolved, it would seem justifiable to advise operation in doubtful cases if there is evidence of severe mitral stenosis. If at operation mitral incompetence is encountered in addition to stenosis, mobilization of the valve leaflets may decrease the severity of the former lesion.

One graph.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

Angio-Cardiographic Diagnosis of Congenital Heart Disease with Cyanosis. Early Experiences with an Inexpensive Cassette Changer. D. E. Paterson. Indian J. Radiol. **8:** 120–139, August 1954.

Angiocardiography was performed on 30 patients at the Christian Medical College Hospital, Vellore, India, in 1953. An inexpensive cassette changer first described by Neuhauser and Jennings (Am. J. Roentgenol. **49:** 829, 1943) was utilized, permitting about one exposure per second. The author discusses the clinical, radiologic, and surgical aspects of heart conditions with a right-to-left shunt. Such shunts occur when there is increased pressure on the right side of the heart, and a defect between right and left sides through which unoxygenated blood can by-pass the lungs. Increased pressure on the right side of the heart occurs in pulmonary stenosis with right ventricular hypertrophy and in pulmonary hypertension. The first is a condition amenable to surgery; the second, being associated with changes in the walls of the pulmonary vessels, is not.

Illustrative cases of Fallot's tetralogy (with infundibular stenosis and with post-stenotic dilatation), pulmonary stenosis with patent interatrial septum, Eisenmenger's complex with right descending aorta, interauricular septal defect, truncus arteriosus, and a single ventricle are reported. The technic of cardiac catheterization also is described, as it bears on the radiologic diagnosis of congenital heart disorders.

Eight angiocardiograms; 2 drawings.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

The Dynamics of the Heart in Complete A-V Block. An Angiocardiographic Study. John Lind, Carl Wegelius, and Henrik Lichtenstein. Circulation **10:** 195–200, August 1954.

In complete atrioventricular block the auricles and ventricles contract independently, with the ventricular rate much the slower. Increased stroke volume at least partially makes up for the slow rate. These known facts were graphically demonstrated by the authors through a rapid angiocardiographic technic (10 films per second in each of 2 planes at right angles). It is interesting to observe in their illustrations how little the auricular systole contributes in the presence of complete block. When auricular systole takes place in early ventricular diastole, it is able to open the A-V valve, but at other times in the cycle a reflux of contrast medium into the venae cavae and hepatic veins is seen. Also, the ventricle fills rapidly in early diastole regardless of whether or not atrial systole takes place at that time.

The increased stroke volume is also demonstrated by the marked changes in caliber of the pulmonary artery between systole and diastole.

Twenty-four roentgenograms; 2 electrocardiograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The Obscure Physiology of Poststenotic Dilatation: Its Relation to the Development of Aneurysms. Emile Holman. J. Thoracic Surg. **28:** 109–133, August 1954.

The phenomenon called poststenotic dilatation was first observed in the subclavian artery beyond a congenital cervical rib. It may also occur beyond a subaortic stenosis, beyond a congenital stenosis of the pulmonic valve, occasionally between a low infundibular stenosis and the normal pulmonic valve, and frequently, but not invariably, beyond a coarctation.

The author demonstrated by studies on dogs that poststenotic dilatation occurs when a stream of small caliber suddenly flows into a vessel of larger diameter, as well as when the stream flows through an abrupt partial stenosis. He also showed that, when a constricted segment of rubber tubing was inserted into an artificial circulatory system, a poststenotic dilatation occurred in the tubing. From these experiments, it is concluded that poststenotic dilatation is the result of the mechanical effect of the operation of natural hydraulic laws which govern the flow of fluid through a conduit, the conduit in this instance being an elastic vessel. The rate of flow varies conversely with the square of the radius of the conduit, so that the velocity

through the stenotic area is greater than through the vessel beyond. In addition, during diastole there is a momentary retardation of flow, which is accentuated beyond the stenosis. Systole then accentuates the rapid flow through the stenotic area, and this rapid stream comes in abrupt contact with the more slowly moving stream in the immediate poststenotic vessel. This action converts high kinetic energy into a high potential energy or lateral pressure. Moreover, the sudden arrest of the rapid stream produces eddies of turbulence and reversed flow.

The turbulence produces alternating high and low pressure waves against the elastic vessel, which cause it to vibrate. These vibrations are recognized as a thrill or a bruit. The maximal effect of this action occurs about 1 to 3 cm. beyond the constriction. Dilatation does not occur proximal to the stenosis, because there are uniform distribution of pressure and uniform expansion of the vessel with the pulsations. Widening of the stream also produces a lower velocity and an increase in the lateral pressure.

Clinical observations confirm the importance of the height of pressure and velocity of flow. Clinical poststenotic dilatation occurs most prominently in the ascending aorta beyond a subaortic stenosis, where the left ventricle ejects blood under maximal pressure, at a maximal velocity, in maximal mass, against a maximal peripheral resistance. It is prominent also beyond a stenosis of the pulmonic valve, where the hypertrophied right ventricle ejects an equally large mass of blood under high pressure and at high velocity. It is less pronounced beyond a coarctation. Here the pulsatile end-pressure is less than in the ascending aorta, the distal peripheral resistance is less, and the mass of blood forced through the coarctation and resulting velocity of flow have been reduced by the escape of blood through the large branches of the aortic arch. In the vessels of still smaller caliber, dilatation is less likely to occur because of the lower pressure and lower velocity as one approaches the periphery. Also the pulse pressure is reduced. In tetralogy of Fallot, the overriding aorta provides a channel through which blood from the right ventricle is diverted away from the pulmonary outflow tract, and no dilatation of the pulmonary artery is observed.

These observations suggest that the initiating factor in the development of arteriosclerotic aneurysm may occasionally be a stenosis of the arterial lumen imposed by a segmental atherosclerosis, through which a narrowed stream flows with increased velocity into a still normally distensible distal segment, thus setting the stage for the hydraulic forces capable of producing a local aneurysmal dilatation of the vessels.

Once the dilatation has been initiated, the process is enhanced through the application of the principle that a widened lumen slows the stream, slowing of the stream increases lateral pressure, and increasing lateral pressure further dilates the vessels. Sudden increase in arterial pressure may be the additional factor required for rupture of the aneurysm.

The author advises that in vascular surgery end-to-end anastomoses should be made in such a way that they permit growth at the site of union as the body grows, thus avoiding the development of future stenosis.

Twenty-six roentgenograms; 4 photographs; 8 drawings. RENE G. FORTIER, M.D.
St. Paul, Minn.

Arteriovenous Fistula Simulating Patent Ductus, Arteriosus. Evaluation by Venous Catheterization and Angiocardiography. John B. Johnson, Alphonzo Jordan, and John W. Lawlah. J.A.M.A. **155:** 1408–1409, Aug. 14, 1954.

A congenital arteriovenous fistula between a branch of the left subclavian artery and the left subclavian vein is described. The signs simulated patent ductus arteriosus and there was no previous history of trauma or cardiac symptoms. Venous catheterization studies showed increased oxygen content in the subclavian-innominate vein area rather than in the pulmonary artery, as would be expected in patent ductus arteriosus, and the lesion was well demonstrated by angiocardiography. In the presence of findings suggestive of patent ductus, consideration must be given to such vascular conditions as venous hums, traumatic arteriovenous fistulas, aortic septal defects, rupture of a sinus of Valsalva into the heart, and rupture of a syphilitic aortic aneurysm into the pulmonary artery.

Two roentgenograms. SHOZO IBA, M.D.
Huntington Park, Calif.

Absence or Hypoplasia of a Pulmonary Artery with Anomalous Systemic Arteries to the Lung. Herbert C. Maier. J. Thoracic Surg. **28:** 145–160, August 1954.

Various congenital anomalies of the pulmonary and systemic arteries to the lung occur both in association with congenital cardiac lesions and without primary heart disease. The author limits his discussion to (1) absence of the pulmonary artery to one lung and (2) hypoplasia of one lung with anomalous systemic arteries.

Angiocardiography has demonstrated that congenital absence of one pulmonary artery is not so rare as the literature would suggest. Some cases produce no symptoms and are diagnosed only if the findings are suggested on routine chest films. When the blood flow through one pulmonary artery is absent, the respiratory function of such a lung is largely lost. There tends to be an increase in the bronchial circulation corresponding to the amount of functional communication between the pulmonary and bronchial vascular systems.

On the conventional chest film one may find some reduction in the body of the abnormal lung, although the entire lung appears aerated. The normal hilar vascular shadows are absent. The diaphragm of the abnormal side may be elevated. The diminished volume of the lung results in mediastinal displacement toward the anomalous side, with over-distention of the contralateral lung and some degree of mediastinal herniation. Occasionally, fluoroscopy will demonstrate the mediastinal shift in deep inspiration; however, this finding may be absent if the lung ventilates well.

Angiocardiograms demonstrate the fine network of bronchial vessels supplying the lung without a pulmonary artery. These vessels become opacified after the aorta has been visualized and at a time when the pulmonary veins of the contralateral lung have already cleared.

The author presents 3 cases of absence of the pulmonary artery, in all of which there were some symptoms associated with the anomaly. A nine-year-old boy had recurrent pneumonia and hemoptysis. Microscopic examination of the excised lung showed little evidence of inflammation but a uniform fibrosis of the lung, with thickening of the interalveolar septa. A thirty-seven-year old woman complained of a sense of

tightness in the chest and slight dyspnea. In this case small linear densities near the right apex were shown by angiocardiography to represent hypertrophic bronchial arteries. A four-month-old infant had intermittent cyanosis, fever, and dyspnea. Autopsy revealed absence of the right pulmonary artery and an enlarged heart. In the first 2 cases the diagnosis was suspected on the chest films and confirmed by angiocardiography.

Hypoplasia of the lung occurs in varying degrees. If the hypoplastic lung is less than the equivalent of a single lobe, it is unlikely that a clinically significant amount of normal respiratory tissue will be present.

The author presents 3 cases of hypoplasia of the lung. Roentgenograms showed a shift of the mediastinum to the involved side. Angiocardiograms showed small pulmonary arteries with several systemic arteries going to the involved lung. Dyspnea in these patients may be explained on the basis of pulmonary engorgement from the higher intravascular pressure of the systemic arteries entering the lung. In 1 of the patients, operated upon two years earlier, the dyspnea disappeared after interruption of the systemic arteries to the hypoplastic lung. The greater the flow of blood from the systemic arteries to the lung, the greater are the chances of vascular congestion, hemorrhage, and susceptibility to superimposed infection.

Thirteen roentgenograms; 2 drawings.

RENE G. FORTIER, M.D.
St. Paul, Minn.

Superior Vena Cava Obstruction with Complete Obstruction of the Right Main Pulmonary Artery. Gordon W. Briggs, Harold A. Carlson, and John H. Houseworth. Am. Heart J. **48**: 288–292, August 1954.

A case of complete obstruction of the superior vena cava and right main pulmonary artery secondary to a concussion injury is reported.

A 30-year-old Negro soldier was blown from a foxhole in Korea by the explosion of an enemy concussion grenade and immediately coughed up streaks of bright red blood. Following this episode, he was asymptomatic, but some two years later a routine chest film demonstrated contraction of the right hemithorax and fibrosis of the right lung. Angiocardiograms made with contrast material injected in the right antecubital vein showed none of the medium entering the heart from the superior vena cava but demonstrated an extensive collateral circulation by retrograde flow through the internal mammary and azygos venous systems. Angiocardiography was then performed through a tributary of the right femoral vein and complete occlusion of the right main pulmonary artery was demonstrated.

It is believed that the concussion injury of the chest resulted in hemorrhage into the right hilar structures, and that the resulting fibrosis and contraction occluded the superior vena cava, the orifice of the azygos vein, and the right pulmonary artery. It is worthy of note that the patient is completely asymptomatic, with no visible venous collaterals.

Four roentgenograms.

THEODORE E. KEATS, M.D.
University of California, S. F.

Unusual Coronary Branch in a Case of Coarctation. L. Di Guglielmo and M. Guttadauro. Acta radiol. **42**: 141–148, August 1954.

The authors describe a case in which an unusual coronary vessel was visualized in the course of a thoracic aortography. The clinical and radiologic symptomatology was that of aortic coarctation. The aortogram showed the stenosis 2 cm. beyond the origin of the left subclavian artery and excellent filling of the coronary system. Immediately after the commencement of visualization of the coronary arteries, the authors observed the filling of a blood vessel which departed from the upper contour of the anterior interventricular branch of the left coronary artery about 3 cm. from its aortic origin and about 1.5 cm. from the point at which the artery divides into three branches. This vessel appeared to bifurcate immediately into a very fine branch, not clearly visible in its further course, and a long ascending branch, very tortuous and with a lumen of about 1 mm. This ran upward and medially, along the course of the pulmonary artery, and was easily identifiable up to a point situated a little below the stenosed part of the aorta.

It is suggested that this branch represents the cardiopulmonary artery described by Muratori (Arch. sc. med. **82**: 24, 1946) and is pointed out that it may participate in the collateral circulation, carrying blood from the left coronary artery to the descending aorta.

Three roentgenograms; 5 drawings.

THEODORE E. KEATS, M.D.
University of California, S. F.

Portal Venography in Banti's Disease. G. H. Du Boulay and B. Green. Brit. J. Radiol. **27**: 423–434, August 1954.

In 46 patients with Banti's disease portal venography was performed after laparotomy, by injecting 15 to 30 c.c. of Diodone, usually into one of the jejunal veins, and making an exposure at the end of the injection and another about two seconds later.

The chief value of the procedure is to identify suitable veins for anastomosis. It also demonstrates patency of the portal vein, extrahepatic obstruction, cirrhosis of the liver, and gastric as well as esophageal varices.

Twenty-seven roentgenograms; 1 drawing; 1 photograph.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Simultaneous Arteriography of the Abdominal Aorta and of the Arteries of the Lower Extremities. Federico E. Christmann and David Grinfeld. Angiology **5**: 339–352, August 1954.

The authors describe a method of arteriography, based on the French technic, which permits visualization of the abdominal aorta, of its branches, and of the whole arterial system of the lower extremities following a single injection of radiopaque material into the aorta. The procedure has been employed in 8 cases, 6 of which are presented with illustrative roentgenograms. Further improvements in the method are expected.

Distal Operative Angiography as an Aid in Endarterectomy. Wiley F. Barker. Surgery **36**: 233–236, August 1954

Selection of patients for the formidable operation of endarterectomy in the lower extremity remains a problem. Of particular interest are those patients with either no refilling of the distal popliteal segment on angiography, or with questionably satisfactory distal vessels. The benefits of the operation may be extended to some of this group, and the hazards withheld

from others on the basis of distal operative angiography.

All otherwise satisfactory surgical candidates whose femoral arteriograms fail to show the distal segment clearly are subjected to low femoral or popliteal artery exploration. If a soft and patent vessel is found, an arteriogram is taken following injection of 10 to 15 c.c. of Diodrast, Neo-Iopax, or Urokon. Heparin is injected before and after the contrast material.

This technic has been applied to 11 patients. No deleterious effects have been observed. On 6 occasions it has been possible to proceed successfully with endarterectomy in a patient not previously believed to be a good candidate. In only 2 of these 6 patients had any filling of the popliteal vessel been seen on the initial angiogram. In 3 other cases endarterectomy was found to be contraindicated by extensive disease with concomitant gangrene or necrosis, in spite of hopeful preoperative angiograms.

Three roentgenograms.

THEODORE E. KEATS, M.D.
University of California, S. F.

A Technique of Phlebography on the Hind Legs of Rabbits and Guinea-Pigs. R. May and R. Gottlob. Angiology 5: 304–306, August 1954.

A method is described for the injection of contrast medium into the substantia spongiosa of the bone to obtain roentgenograms of the leg veins of rabbits and guinea-pigs. In the rabbit the bone best suited for puncture is the calcaneus, and in the guinea-pig the proximal part of the tibia. A normal phlebogram of each animal is reproduced. In another article in the same journal (pp. 307–311), the authors describe a method for producing thromboses in laboratory animals and their roentgen study by the procedure outlined above.

Two roentgenograms.

THE BREAST

Adenosis of the Female Breast. Helen Ingleby and J. Gershon-Cohen. Surg., Gynec. & Obst. 99: 199–206, August 1954.

Adenosis is defined as unencapsulated parenchymatous hyperplasia. It is a common condition of the breast, frequently not diagnosed or mistaken for other lesions. Parenchymatous hyperplasia accompanies dysplasia in the majority of patients under fifty years of age.

The symptomatology of mammary adenosis is variable. Premenstrual pain and the disappearance of pre-existing tumors are the most common symptoms. On clinical examination the masses closely resemble cysts or fibroadenomas. In many doubtful cases the x-ray examination will lead to the diagnosis.

The following roentgen criteria are based on a review of 618 breast operations which included 50 cases of uncomplicated adenosis.

(1) Fluffy or blurred opacities with a texture suggestive of ground glass. The patches are oval or partly oval rather than round.

(2) Sharp margins partially outlining some areas, which resemble incompletely encapsulated fibroadenomas.

(3) Bilateral lesions, more developed on one side than the other. In generalized adenosis, the films were dotted over with small fluffy opacities reminiscent of melting snowflakes.

Cysts and fibroadenomas are distinguished from adenosis by their smooth sharp margins and by displacement of breast trabeculae, which in adenosis merge with the involved areas.

Microscopically, four types of adenosis may be distinguished. More than one type may be present, but usually one is predominant.

Type A: Well formed lobules with hyperplasia of epithelial and myoepithelial cells. Normal development of ductules.

Type B: Commonest form of adenosis. Lobules consisting of dilated ductules with hyperplasia of myoepithelium.

Type C: Resembling Type B but with scanty or absent myoepithelium.

Type D: Sclerosing adenosis.

Adenosis may disappear, undergo fibrosis, or lead to cyst formation. Type C may be precancerous. The authors stress that the importance of the condition does not lie with the lesion itself, but with its ultimate fate. Their object is prognosis rather than diagnosis. Years of study and follow-up of patients will be required before this aim can be fully achieved.

Five roentgenograms; 8 photomicrographs.

JAMES A. LYON, M.D.
University of Pennsylvania

THE DIGESTIVE SYSTEM

Carcinoma of the Esophagus. A Review of Fifty Cases. M. Meredith Brown. Brit. M. J. 1: 1462–1464, June 26, 1954.

Fifty consecutive patients with malignant disease of the esophagus were seen in the Thoracic Surgical Unit of St. Thomas's Hospital (London) during 1951 and 1952, the esophagus being involved secondarily in one-third of the cases. In January 1954, only 6 of the series were alive. More than half the patients were over sixty years of age; 29 were men.

The commonest symptom of esophageal cancer is difficulty in swallowing, and it is usually this which leads the patient to seek advice. Loss of weight, regurgitation, and pain are also frequent symptoms.

The barium swallow and esophagoscopy are important in making a correct diagnosis. In the 50 cases forming the present series, the barium swallow gave an appearance suggestive of carcinoma in 36 instances. Other impressions were stricture or obstruction, without indication of its nature, in 5 cases; an extrinsic mass in 4; achalasia in 3; esophagitis in 1. In 1 patient barium was not given. Esophagoscopy was done on 44 patients, and the gross appearance suggested carcinoma in 39. A positive biopsy was obtained in 39; negative in 4.

In all of the 32 primary lesions the histological picture was that of squamous-cell carcinoma. In 17 cases the esophagus was involved by direct extension of a neoplasm in an adjacent viscus, the bronchus in 1 and the stomach in others. In the remaining case, the lesion in the esophagus was metastatic from a carcinoma of the rectum. The spread of the primary esophageal lesions occurred directly into the surrounding structures; widespread dissemination is quite unusual.

The treatment policy called for radical surgery when possible. When radical resection was impossible, palliative surgery was done if feasible. Other palliative procedures were esophagoscopic dilatation and intubation and irradiation. Exploratory surgery was

undertaken in 24 cases and it was possible to do a radical resection in 7. Eight patients were treated by irradiation.

Five patients left the hospital after radical resection and were alive and well at the time of this report, having lived forty-eight, thirty, twenty-nine, eighteen, and fourteen months from the time of surgery. Of the 8 patients treated by irradiation, 1 was alive and well twenty-eight months after her first symptoms. The other 7 died four, five, eight, nine, thirteen, fifteen, and forty-one months after the appearance of symptoms.

Two tables. DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Reflux Esophagitis. W. C. Sealy, George Baylin, and Gordon Carver. South. M. J. **47**: 773–777, August 1954.

Reflux esophagitis is an inflammation of the esophagus from the corrosive action of digestive juices regurgitated because of functional failure of the cardiac sphincter. The causes of this failure are surgical excision of the sphincter, a sliding hiatus hernia, or repeated vomiting.

One hundred and thirty cases of reflux esophagitis from Duke Hospital (Durham, N. C.) were reviewed. In 98 of these, x-ray examination showed a hiatus hernia. Fifteen patients had persistent vomiting, and each of these had a hiatus hernia. Seventeen patients had had surgical destruction of the cardiac sphincter because of achalasia, tumor, or chemical burn. One hundred patients complained on admission of dysphagia or aphagia, 91 of substernal pain, 52 of regurgitation, and 13 of hemorrhage.

Forty-seven cases in the present series were treated conservatively with fair results. In another 46 dilatations were carried out in addition to medical measures. In only 37 instances was surgery employed: repair of hiatus hernia in 15; gastrostomy and retrograde dilatations in 9; gastric resection and repair of hernia in 2; gastric resection and dilatation in 1; phrenic nerve crush in 1; resection of the esophagus in 7; cardioesophagoplasty in 2.

Curling of the Oesophagus. P. van Exter and A. D. Keet, Jr. South African M. J. **28**: 206–211, March 13, 1954.

"Curling" is the term applied to the abnormal radiological appearance of the esophagus produced by tertiary contractions with suppression of the primary and secondary peristaltic waves. Recognition of the condition requires acute observation during fluoroscopic examination. The condition may take the form of rippling, multiple functional diverticula, ladder spasms, segmental spasms, rosary esophagus, or a corkscrew appearance.

Although the pathogenesis is uncertain, the condition appears to be the result of a neuromuscular dysfunction. Three mechanisms are suggested: (1) a contraction of voluntary fibers which are situated abnormally far down the esophagus; (2) disruption of the normal interplay between the longitudinal and circular muscles as a result of lesions of the myenteric nerve plexuses; (3) inhibition of vagal stimulation or over-action of sympathetic stimulation due to disease of the central nervous system.

Curling gives rise to symptoms in a minority of cases. The authors present 4 case histories with associated radiographs to illustrate the varying appearances and findings.

Ten roentgenograms. E. E. TENNANT, M.D.
Sterling, Colo.

Carcinoma of the Cardia. H. J. Anderson and H. B. Kelly. Brit. M. J. **1**: 1457–1461, June 26, 1954.

The course of 26 cases of carcinoma of the cardia is reviewed. Fifteen of the patients were men, with an average age of fifty-seven, and 11 were females, with an average age of sixty-five years.

Symptoms were usually present from two to six months before the patient came to the hospital; at times the duration was as long as a year. Twenty-four patients complained of dysphagia, with food sticking in the lower sternal area. Regurgitation occurred at some time in 21 patients. There was pain upon swallowing, in the xiphisternal or retrosternal regions, in 12 cases.

Findings on a barium meal examination suggestive of carcinoma of the cardia were: (1) an irregular filling defect at the junction between the esophagus and stomach, which, however, may be indistinguishable from carcinoma of the esophagus; (2) deformity of the fundal gas shadow by the neoplasm (to be distinguished from the large rugal folds in the fundus of the stomach); (3) an irregularity or splitting of the stream of barium as it passes through the cardia; (4) "half-shadowing" at the shoulder of the narrowed segment.

The most careful radiological examination may sometimes fail to disclose a carcinoma of the cardia even when obstruction is present in the distal esophagus; a "negative" examination does not exclude the possibility of neoplasm. Several factors contribute to this lack of accuracy. First, with a partial obstruction at the cardia, the "hungry" stomach may pass the barium through the pylorus so rapidly that a sufficient residue does not remain in the stomach to outline the cardia. Second, the obstruction at the cardia may be complete enough to prevent barium from entering the stomach in sufficient quantity to outline the fundus satisfactorily. This may occur even when the neoplasm is quite small, and a diagnosis of primary achalasia may be made.

Five roentgenograms.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Kinking, Rotation, and Twisting of the Stomach with Special Reference to Cascade Stomach and Chronic Gastric Volvulus. E. A. Spriggs and O. A. Marxer. Brit. M. J. **2**: 325–330, Aug. 7, 1954.

In routine radiologic work, the stomach is sometimes seen to be kinked upon itself (the "cascade" form), or rotated in its entirety (the more obvious variety of volvulus), or twisted like a cloth being wrung dry (torsion of the stomach). These conditions are often associated in the same patient and sometimes cause similar symptoms. The authors report a series of 44 cases, with cascade stomach predominating, either alone (19 cases) or in association with other types of twisting or rotation (11 cases). In only 9 of this series did the main symptoms for which relief was sought appear to be related to the gastric deformity. In 8 there were severe attacks of abdominal distention.

The evidence indicates that there is an association between certain abnormal stomach forms and gastric pneumonitis, but which is cause and which effect is not

clear. The author also mentions the frequent finding of large amounts of gas in the colon, but this is inevitable in patients who swallow large amounts of air. Related to the aerophagia is the interesting observation that 3 patients in the series gave a history of disruption of surgical incisions from distention.

Brief case histories are included illustrative of longitudinal and transverse volvulus, as well as twisting in various portions of the stomach. One forty-eight-year-old housewife, with a transverse rotation, gave a history of angina-like attacks of pain. When electrocardiograms were taken, however, the findings were negative. Gastropexy was performed, but subsequent roentgenograms showed a recurrence of the condition. The authors do not state whether the attacks have continued in this patient or whether they were relieved for a time after operation.

Seven roentgenograms; 7 drawings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Benign Ulcer of the Greater Curvature of the Stomach. Belton G. Griffin. Gastroenterology **27:** 178–182, August 1954.

A presentation of the clinical, pathological, and roentgenographic data in 3 cases of benign peptic ulcer of the greater curvature of the stomach increases the reported incidence of this unusual condition to 59 cases (24 discovered at autopsy only).

Three roentgenograms.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Giant Lesser-Curve Gastric Ulcers. Denys Jennings and J. E. Richardson. Lancet **2:** 343–350, Aug. 21, 1954.

The symptoms in patients with giant gastric ulcers are almost invariably atypical, and the risk of misdiagnosis and mistreatment is great. Seventeen consecutive cases of giant lesser-curvature ulcers (smallest diameter greater than 3 cm. in the unstretched stomach) are reported from the London Hospital, and possible etiological factors are discussed.

Of the 17 patients, 10 presented with giant simple ulcers, including 2 with hemorrhage. In 7 of the remaining 8 cases in this group, a diagnosis of inoperable carcinoma was made, and in 3 this had serious consequences. Six patients had an ulcer less than 3 cm. in diameter when first examined roentgenologically, but later, after months or years, a giant ulcer was found; 3 of these cases were treated conservatively.

In some cases psychological factors biased the clinician toward an initial diagnosis of non-organic indigestion. Later, a disturbance of colonic function usually led to increasing doses of aperients. In the final stage the patients were obviously severely ill and the pain tended to have a retroperitoneal type of distribution; it went through to the back or was referred to the iliac fossae or to the suprapubic region; in other cases there was severe chest pain. The absence of a typical ulcer history and the poor condition of the patient now suggested carcinoma. The gross and atypical x-ray findings prevented the radiologist from correcting the clinical mistake. The pathologic dictum that ulcers more than an inch in diameter are usually malignant (MacCarty, W. C.: Radiology **34:** 1, 1940), which obviously does not apply to x-ray niches above the angulus, also contributed to error. Diagnosis is primarily radiological. In the authors' opinion there is little excuse for considering the possibility of carcinoma unless after several weeks of treatment the ulcer is seen to be "filling in" from the base rather than healing by contraction.

Only 1 of the 17 giant ulcers proved to be carcinomatous. Giant carcinomatous ulcers are common—in the five years covered by the authors' survey more than 50 were excised at operation on the surgical unit of London Hospital alone, but none of the 50 produced a "giant" lesser-curve niche above the angulus. A large carcinomatous ulcer leads to a localized loss of elasticity, and when a barium suspension is swallowed, the unaffected part of the stomach balloons out around the rigid area, which thus forms an irregular filling defect or stricture, but rarely a niche. The chief exception to this rule is when part of a malignant ulcer is eroded more deeply than the rest, giving the appearance of a small or medium-sized niche with a ragged edge.

Of the 16 patients with simple ulcers, 4 were dead at the time of the report: 2 from hemorrhage, 1 from inanition, and 1 from hypertensive heart failure; in 3 of the fatal cases a wrong diagnosis was a contributory factor. Seven patients were treated by partial gastrectomy and 5 were treated medically.

Thirteen tracings of roentgenograms; 6 graphs.

Some Aspects of the Diagnosis of Malignant Alteration of Gastric Ulcer (Comparative Radiologic and Histologic Study). Franco Perotti. Radiol. med. (Milan) **40:** 758–773, August 1954. (In Italian)

While opinions vary concerning malignant change in a benign gastric ulcer, the author thinks that such a process occurs. Certainly the histologic distinction between a secondary neoplasm arising in a chronic ulcer and primary neoplasm is a fine one; often it is not possible. Even if agreement is not universal that all the author's cases represent secondary malignant change, his radiologic differentiation between benignity and malignancy still would be worth while. Twelve cases are presented in their radiologic and histologic aspects, representing the gradual transition from simple benign ulcer, through intermediate stages, to frank cancer.

Malignant change appears to be related to the atrophic gastritis about the ulcer and its fibrosis. The malignant ulcer appears less deep, with a large mouth, no collar, diverging edges as one proceeds towards the lumen, either slightly elevated or not at all. These findings, as opposed to those in the benign ulcer, are explained by the marked tissue sclerosis, with resulting lack of plasticity of the margins and failure of smooth muscle contraction. The typical appearance of the benign ulcer is conditioned by the relative intactness of the surrounding tissues, permitting edema and smooth muscle contraction. The healing benign ulcer reaches a stage in which the radiologic appearance resembles the sclerotic or malignant ulcer, but the radiologic course separates these two groups.

A mammillated appearance of the tissue immediately about the ulcer is strongly suggestive of malignant alteration. The nodulation is not neoplastic itself, but is produced by the furrows due to the underlying sclerotic retraction. It seems, therefore, that the radiologic evidences of malignant change are due to the fibrotic proliferation and retraction, rather than to the actual neoplastic tissue. There is probably a pathogenetic relationship between the fibrosis and neoplasm.

The author's 12 cases are neatly divided into simple benign ulcer, atrophic gastritis, atypical epithelial cells with displacement in the submucosa, incipient cancer still limited to the mucosa, and finally frank cancer.

The author thus feels that he can diagnose malignant change in these ulcers indirectly by diagnosing the simultaneous scarring. With this sclerosis, cancer has either occurred or is in the process of occurring.

Thirty-two figures, including 12 roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Absorption of Radioactive Vitamin B_{12} After Total Gastrectomy. Relation to Macrocytic Anemia and to the Site of Origin of Castle's Intrinsic Factor. James A. Halsted, Marvin Gasster, and Ernest J. Drenick. New England J. Med. **251**: 161–168, July 29, 1954.

For this study Co^{60}-labeled Vitamin B_{12} was given to a group of 11 patients who had undergone total gastrectomy two months to seven years previously. The stools were collected for five days after the administration of the radioactive B_{12}, were ashed, and studied with a scintillation counter. The total amount of the material present in the specimens was accumulated for determination of total excretion. It was found that radioactivity was nearly always absent or negligible by the fourth day. The authors feel that the inherent error in the counting technic would not exceed 3 per cent.

In 9 of the cases surgery had been done for carcinoma, in 1 for leiomyosarcoma of the stomach, and in 1 for benign ulcer. These 11 patients excreted, on the average, 87 per cent of the material administered in sixteen tests. However, when a source of intrinsic factor (such as gastric juice or intrinsic-factor concentrate) was administered with the test dose, an average of only 20 per cent was excreted in fourteen tests.

Eleven normal individuals used as controls excreted, on the average, 33 per cent of the oral radioactive B_{12}. Three patients with idiopathic achlorhydria excreted 34 per cent of the radioactive B_{12}. Seven patients with pernicious anemia were also studied and were found to excrete an average of 93 per cent in ten tests. In 4 patients in this group who received also a source of intrinsic factor, the amount of fecal excretion was decreased to an average of 38 per cent.

None of the 11 patients who had had total gastrectomy had a macrocytic anemia. Nine had received prophylactic therapy that would prevent macrocytic anemia. Another point to consider is that a certain interval of time would normally have to elapse (up to three years) before a macrocytic anemia would develop even if the intrinsic factor were not given.

These studies indicate that, in patients in whom total gastrectomy has been performed, failure to absorb vitamin B_{12} is due to lack of the intrinsic factor, since, when this was given simultaneously with the vitamin, the absorption was greater than in normal controls. It is also indicated that the stomach is the only site of secretion of the intrinsic factor in man.

One graph; 4 tables.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

An Evaluation of Gastroscopy. Arthur P. Klotz, Joseph B. Kirsner, and Walter L. Palmer. Gastroenterology **27**: 221–226, August 1954.

Errors in gastroscopic and roentgenographic diagnosis of gastric diseases are analyzed. The complementary value of the two procedures is well proved in an analysis of 1,382 combined examinations. An inconclusive or erroneous diagnosis by either gastroscopy or roentgenography alone was reduced from about 30 per cent to about 10 per cent when both procedures were combined, and only one lesion is known to have been completely overlooked.

Almost 5 per cent of 506 patients thought to be normal roentgenographically were found gastroscopically to have disease: 14 of these had benign gastric ulcers, 4 had malignant lesions, and 6 had polyps. Conversely, over 10 per cent of 482 patients thought to be normal by gastroscopic examination were found to have disease roentgenographically. Most of these had gastric, stomal, or prepyloric ulcers.

Gastroscopy is particularly valuable in differentiating large rugal folds from neoplasms. Antral, marginal, or jejunal ulcers are poorly visualized gastroscopically.

Five tables. RICHARD E BUENGER, M.D.
Chicago, Ill.

The Genesis of Gastric and Certain Intestinal Diverticula and Enterogenous Cysts. N. G. B. McLetchie, J. K. Purves, and R. L. deC. H. Saunders. Surg., Gynec. & Obst. **99**: 135–141, August 1954.

The authors present the case of an infant with feeding difficulties, respiratory embarrassment, and bouts of melena. The radiographic findings indicated an intrathoracic cyst, which varied in size and contained an air-fluid level, and developmental anomalies of the sixth cervical vertebra, representing a vertebral cleft.

At autopsy, except for complete loss of mucosal pattern of the corpus of the stomach, the esophagus and stomach were normal. The first and second portions of the duodenum were surrounded by an annular pancreas, beyond which there was perforation of the duodenum. Arising from the superior aspect of the duodenum and passing through the annular pancreas was a thin tube-like structure leading to a left hemi-diaphragmatic hiatus, through which it expanded into a pouch that measured 7 cm. when expanded. The mucosa and musculature of the pouch were of the type found in the normal stomach. Extending posteriorly from the pouch and reflected over the vertebrae was a strand of dense fibrous tissue.

The fact that this large diverticulum or accessory stomach extended upward through the diaphragm and was connected to the vertebral column suggested to the authors a similarity to the alimentary diverticula and "neurenteric" strands occurring in association with spinal deformities of the combined spina bifida type. Embryologically the vertebral cleft and "neurenteric" connections have been attributed to an ecto-entodermal adhesion of the alimentary tract through a cleft notochord to the neural tube during the pre-somite phase of development. Such an adhesion may be found at any level of the alimentary tract from the esophagus to the terminal ileum. As development proceeds, the ecto-entodermal connection may give rise to traction diverticula, cysts, or neurenteric strands of various extent along the line of attachment. Diverticula may occur at either or both ends of the attachment, and intra-abdominal or intrathoracic cysts may be some distance from the gut but associated with it through the strand-like remains of an attenuated diverticulum. Should the band fail to elongate, interference with diaphragmatic development will ensue.

Most of the thoracic diverticula or cysts connected

with the stomach, duodenum, or jejunum lie in the right hemithorax or to the right of the mediastinum. The cause for this tendency is probably a dextrolateral displacement of the "neurenteric" connection by the developmental processes of gastric and gut rotation.

The roentgenographic evidence of partial or complete vertebral clefts, which may involve any segment of the spinal column but are most commonly found at the cervical or thoracic levels, should bring to mind the possibility of co-existing alimentary cysts or diverticula.

One roentgenogram; 1 photograph; 3 drawings.

JOHN H. HARRIS, JR., M.D.
University of Pennsylvania

Anomalies of Intestinal Rotation and Mesenteric Fixation. Review of the Literature With Report of Nine Cases. Gordon Manson. J. Pediat. **45:** 214–233, August 1954.

From a review of the literature, five points are brought out in regard to anomalies of intestinal rotation: (1) Most such anomalies involve the midgut loop and its derivatives. (2) Minor abnormalities of mesenteric fixation are common. (3) These anomalies may be asymptomatic throughout life. (4) Obstruction is most likely to occur in infancy and childhood. (5) The sexes are equally affected.

The three stages of embryological rotation of the bowel are reviewed, and the various anomalies related to each stage are discussed. Extroversion of the cloaca is the only anomaly associated with failure in the first stage of intestinal rotation. Malrotation with or without omphalocele, reversed rotation with retroposition of the transverse colon or paraduodenal hernia, and duodenum inversum are the three anomalies associated with a failure in the second stage. A failure in the third stage of rotation results in incomplete fixation of the colon or anomalous fixation of the duodenum. The anatomic features of each of these anomalies and the complications to which each is prone are described. Nine cases are reported as examples and treatment is briefly discussed.

Seven roentgenograms; 1 drawing; 3 tables.

H. G. PETERSON, JR., M.D.
New Britain, Conn.

Intussusception in Adults. Donald Brayton and William J. Norris. Am. J. Surg. **88:** 32–42, July 1954.

The authors review 665 cases of intussusception in adults reported in the English literature between 1900 and 1947, and 80 cases reported between 1947 and 1954. In addition, they present 5 cases of their own in detail.

Among the 745 cases reviewed, 52 per cent were of small-intestinal origin and 38 per cent of colonic origin. Benign tumors caused 33 per cent, and malignant growths 21 per cent. The relative incidence of benign and malignant tumors causing intussusception in the colon is stressed. Tumors were responsible for colonic intussusception in 166 instances among the 283 cases reported between 1900 and 1947. Of these, 71 were benign and 95 malignant. Among the 80 later cases, tumors were the inciting factor in 39 instances, 15 benign and 24 malignant. Thus, in the recent series 56 per cent of all intussusceptions of the colon were caused by a malignant neoplasm.

Intussusception in adults is manifested by symptoms of partial small-bowel obstruction. In cases reported since 1947, blood occurred in the stools in only 38 per cent and a palpable mass, usually not tender, in 49 per cent. The authors stress the primary importance of roentgenographic studies. The treatment is surgical. When x-ray studies show the colon involved in intussusception, the condition should be treated as malignant.

Eleven illustrations, including 2 roentgenograms; 4 tables.

R. F. LEWIS, M.D.
Cleveland Clinic

Chronic Duodenal Ileus. Emilio M. Canlas. Missouri Med. **51:** 649–652, August 1954.

Duodenal ileus is characterized by intermittent delay in the passage of duodenal contents through the transverse duodenum due to compression by the root of the superior mesenteric artery, vein, and nerve. It is usually found in patients of the asthenic habitus with lordosis and visceroptosis.

Anatomically the transverse duodenum is the most fixed portion of the alimentary tract. It lies behind the peritoneum, in contact posteriorly with the aorta and the spine and anteriorly with the mesenteric vessel sheath. The superior mesenteric artery arises from the anterior part of the aorta at the level of the first lumbar vertebra and passes downward and forward, anterior to the third portion of the duodenum. In many postmortem specimens there is a visible groove on the anterior wall of the transverse duodenum made by its contact with the superior mesenteric vessels. In asthenic subjects this depression is deeper and more prominent than in others.

The most important causes of duodenal ileus are: (1) pressure by the superior mesenteric vessels, (2) congenital or acquired bands or adhesions, (3) anomaly of the curvature or rotation of the duodenum by tumor or inflammatory scar tissue. Predisposing causes are (1) a short mesentery which does not rest on the pelvis or against the anterior abdominal wall, (2) a relaxed redundant abdominal wall which affords no support for the intestinal mesentery, (3) lordosis, which undoubtedly diminishes the compartment occupied by the transverse duodenum, causing that structure to lie on a slightly convex surface which allows for increased mesenteric compression.

From a radiological point of view, two conditions are necessary for the recognition of duodenal ileus: (1) dilatation of the duodenum and (2) retention of barium in the duodenum beyond the normal time limit. Plain films of the abdomen and an upper gastrointestinal examination are essential for diagnosis.

Patients with duodenal stasis due to real mechanical obstruction with gradual narrowing of the lumen will usually have more or less constant vomiting without periods of well being, whereas in duodenal stasis without demonstrable obstruction, the vomiting, pain and epigastric distress, and other digestive disturbances come on in an attack associated with emotional disturbances or fatigue.

Medical management together with abdominal and postural exercises will apparently relieve the symptoms, and surgery is probably not necessary unless complications are present.

Two cases are reported.

Six roentgenograms.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Fibroma of Ileum (Diagnosed Preoperatively by Barium Enema as Benign Polypoid Tumor) and a Review of Benign Small Intestinal Tumors. Alex E. Pearce, Morris Ivker, and Samuel Oller. Surgery **36:** 299–305, August 1954.

The authors report a fibroma of the ileum which produced intussusception and state that it is the first small bowel tumor to be diagnosed by barium enema preoperatively as a benign polypoid lesion.

The patient was a 62-year-old woman complaining of recurrent periumbilical cramps. A barium enema showed a smooth, polypoid mass in the ileum 45 cm. from the ileocecal valve. The preoperative diagnosis was benign polypoid tumor of the ileum associated with recurrent intussusception.

At surgery a pedunculated, intraluminal tumor of the terminal ileum, 45 cm. from the ileocecal valve and measuring 3 cm. in diameter, was found. The terminal ileum was intussuscepted for approximately 25 cm. The intussusception was reduced, 25 cm. of the ileum with the tumor in the center was resected, and an end-to-end anastomosis performed. The microscopic diagnosis was fibroma with degenerative changes.

Tumors of the small intestine should be considered when melena occurs and when studies of the esophagogastric duodenal area and the colon are negative. This diagnosis should also be considered when intussusception is suspected or when small bowel obstruction occurs in an adult who has had no previous intra-abdominal surgery.

The literature in relationship to benign small bowel tumors is reviewed.

Two roentgenograms; 1 photomicrograph; 1 photograph; 1 table. THEODORE E. KEATS, M.D.
University of California, S. F.

Hirschsprung's Disease in the Newborn. Russell R. Klein and Robert A. Scarborough. Am. J. Surg. **88:** 6–14, July 1954.

Five case reports of Hirschsprung's disease in newborn infants are presented as well as a discussion of the diagnosis and treatment. Errors in diagnosis and injudicious delay in surgical decompression of the colon are given as major reasons for the high mortality associated with this abnormality in the newborn. A survey of 50 cases reported in the literature disclosed a mortality of approximately 70 per cent.

The clinical picture in all 5 of the authors' cases was similar, beginning with regurgitation on the first or second day of life. Shortly thereafter there was abdominal distention, severe enough that plain films of the abdomen were obtained. In all cases meconium was passed in small amounts and perhaps some soft stool, but in none was bowel function considered normal.

The plain films in all 5 cases showed distention of small and large bowel, but no air in the rectal ampulla. This is a common finding in a normal infant. It is emphasized that in the newborn a barium enema usually does not show any disparity between dilated colon and undilated rectum. The examination is done to rule out mechanical block. Evacuation is poor in these infants. Retention of barium at twenty-four hours is suggestive of Hirschsprung's disease when the filled colon appears normal.

Among conditions to be differentiated are feeding problems, imperforate anus, atresias of the intestine, malrotation, meconium ileus, and intussusception. The authors state that the common misdiagnosis is congenital atresia, which is a rare entity in the colon.

Treatment is surgical, with prompt decompression by colostomy. Definitive resection can be delayed until the second or third year, but biopsy and frozen section of rectal musculature should be performed at the time of decompression to establish the diagnosis and to determine the length of the aganglionic segment. The colostomy should not be placed in an aganglionic segment.

Four roentgenograms. R. F. LEWIS, M.D.
Cleveland Clinic

Clinical and Roentgenological Evaluation of Banthine on the Motility of the Colon. Michael H. Streicher. Am. J. Digest. Dis. **21:** 207–211, August 1954.

A series of 90 patients, including 10 with ileostomies, 46 with ulcerative colitis, 7 with spastic colitis, and 27 with constipation, were studied as to colon motility before and during Banthine therapy. Similar studies were made in 10 normal subjects. Evaluation of motility was made clinically by determining the variation in the average number of stools daily before and after Banthine, by the presence or absence of abdominal pain and cramping (referable to the colon), and by the presence or absence of blood in the stool.

Roentgenologically a comparison was made of the emptying time of the colon, in hours, before and after oral administration of Banthine. A standard amount of barium was given to each patient by mouth. Barium progress was visualized daily by continuous fluoroscopy and by repeated films. Banthine reduced the motility in all subjects, with the greatest delay demonstrated roentgenologically in the cecum.

Five tables. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Venous Invasion in Carcinoma of the Rectum as Evidenced by Venous Radiography. Mitchell S. Madison, Malcolm B. Dockerty, and John M. Waugh. Surg., Gynec. & Obst. **99:** 170–178, August 1954.

Venous invasion in carcinoma of the rectum affects the prognosis adversely. Gross and microscopic search for venous invasion in the surgical specimen has not given entirely satisfactory results, and the authors have accordingly devised a new radiopaque venous injection technic for localizing zones of vascular narrowing radiographically. Tissue blocks taken from such areas reveal a high incidence of malignant invasion.

With the aid of this injection technic, venous invasion, proved microscopically, was found in 42.9 per cent of 42 carcinomas of the rectum. The incidence was 31.4 per cent among patients on whom resection was performed with the hope of cure. Roentgenograms revealed venous obstruction or deficiency in 83 per cent of the cases with proved microscopic invasion, and such obstruction or deficiency was absent in 87 per cent of cases which did not show microscopic evidence of venous invasion.

Four roentgenograms; 6 photomicrographs; 3 tables.
HENRY P. PENDERGRASS, M.D.
University of Pennsylvania

Compression Mucosal Studies with a Pneumatic Paddle. Samuel L. Beranbaum. Am. J. Digest. Dis. **21:** 187–190, July 1954.

A compression device is described to aid in mucosal spot-filming in the horizontal position. The compres-

sion is made by a balloon which may be inflated to any desired degree. The inflating bulb is at the end of the handle. The balloon is surrounded by a metal ring to facilitate placement. A number of examples of its use are illustrated.

Eleven roentgenograms; 2 photographs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Annular Pancreas Producing Duodenal Obstruction in Infancy. Report of a Successfully Treated Case. Wilfred T. Small and Carroll Z. Berman. New England J. Med. **251:** 191–193, July 29, 1954.

Annular pancreas is a rare congenital anomaly in which a band of pancreatic tissue encircles the second portion of the duodenum. The degree of obstruction produced varies. At times the anomaly will be discovered only as an incidental autopsy finding, while at other times symptoms of high intestinal obstruction may appear in the newborn infant.

The authors' case is of the latter type. The patient was an infant two days old. An x-ray examination of the abdomen showed gaseous distention of the stomach and proximal duodenum, with no gas in the gastrointestinal tract beyond this level, localizing the obstruction to the duodenum. Surgery was performed on the third day of life, and the second portion of the duodenum was found to be encircled by a ring of glandular tissue 1 cm. in width, which was continuous with the head of the pancreas. A posterior duodenojejunostomy was followed by an uneventful recovery.

The position of the gas in the gastrointestinal tract will localize the level of obstruction when it is complete, as in this case. When obstruction is incomplete, a barium meal will be of value in showing the annular narrowing of the duodenum. In the differential diagnosis duodenal stenosis or atresia and midgut malrotation are to be considered.

One roentgenogram; 2 drawings.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Intravenous Cholecysto-Cholangiography (Biligrafin Intravenous) with a Comparative Survey of the Oral and Intravenous Methods. R. F. Sethna. Indian J. Radiol. **8:** 140–159, August 1954.

The author examined the biliary tracts of 74 patients by intravenous injection of Biligrafin (marketed in the United States as Cholografin). Twelve patients were given doses of 40 c.c.; 62 received doses of 20 c.c. In 45 patients visualization of the gallbladder was normal. In 12 patients there was no visualization: in 5 of these calculi were visible on the roentgenograms or were found at subsequent surgery; most of the others had clinical diagnoses of infective hepatitis.

In 14 patients visualization of the gallbladder was faint or poor. All were considered clinically to have chronic cholecystitis, and 8 were shown to have gallstones.

The total visualization of the gallbladder in the series was 83.3 per cent, which is considered to compare favorably with figures reported for oral cholecystography. The author achieved faint visualization by the intravenous method in 3 patients in whom the oral method had been unsuccessful.

Wide discrepancies exist among reports in the literature concerning visualization of the extrahepatic ducts by the oral method, with percentages of successful visualization ranging from 10.5 to 91. The author gives no figures from his study, but believes that visualization by the intravenous method is high. He considers that diameters of the common bile duct in excess of 5 mm. strongly suggest pathological dilatation. It is his belief that intravenous cholecystography offers advantages over the oral method which will cause it gradually to supersede the latter.

Nineteen roentgenograms; 2 photographs; 4 tables.

ARTHUR S. TUCKER, M. D.
Cleveland Clinic

The Emptying and Filling Process in the Biliary Tract. H. Anacker. Fortschr. a. d. Geb. d. Röntgenstrahlen **81:** 143–150, August 1954. (In German)

The author studied the physiology of both the gallbladder and the ducts by means of serial films and fluoroscopy following the intravenous injection of Biligrafin (Cholografin). The medium entering the gallbladder is either visualized as a homogeneous density from the beginning of the study, or gradual filling is observed from the infundibulum to the fundus. Even with perfectly homogeneous filling, if the examination is conducted with the patient standing, layer formation may take place. This may simulate the appearance caused by the presence of small calculi or gravel and calls for careful differentiation.

Gallbladder emptying is normally facilitated by assumption of the upright posture. Active peristaltic contractions have not been observed with the new medium, even after a fat meal, unless definite resistance was present. With an open papilla, a stream of bile has been seen to enter the duodenum. As emptying is completed, the papilla contracts and very often the lower segment of the duct shows similar contraction. This recurs at rhythmic intervals. There is apparently little or no relationship to peristalsis in the duodenal loops. Nervous and hormonal influences undoubtedly play a part in these mechanisms. The appearances above described were observed to be definitely less active when the patient was lying down.

Thirteen roentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Simultaneous Cholecystocholangiography. Preliminary Report. L. Lange. Fortschr. a. d. Geb. d. Röntgenstrahlen **81:** 150–155, August 1954. (In German)

The use of Biligrafin (Cholografin) allows visualization of the biliary duct system and the gallbladder. The ducts, however, are visualized to best advantage about one-half hour after injection and the gallbladder is best observed after a longer interval, two or three hours. The author aims to obtain filling of both gallbladder and ducts by a divided dose technic, thereby obtaining information as to both phases, to better advantage, on a single study. Complete filling of both gallbladder and ducts presupposes a normally functioning liver and patulous ducts.

The patient is prepared with an enema the evening previous to the examination. Twenty cubic centimeters of Biligrafin is injected intravenously, with the patient lying on the right side. Between two and one-half and three hours later, another 20 c.c. is injected and films are made with the patient prone, with the right

side raised 45 degrees to free the ducts from superimposition of the spine. The first injection is responsible for filling of the gallbladder and the second injection for filling of the ducts. Tomographic studies may be made and occasionally assist greatly in identification of calculi. Serial films may be obtained and various angles used to allow for individual differences in the patient's build.

In normal cases the author has successfully demonstrated both the gallbladder and ducts very well and believes that this procedure aids in identifying calculi, obstructions, and other pathological changes.

[The author does not specify a fat-free meal as preliminary preparation but it would certainly seem to be advisable.—E.W.S.]

Six roentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Experiences with Cholangiography during Surgery. Martin A. Howard. Am. J. Surg. **88**: 56–64, July 1954.

The basis for the present paper is 259 cases in which cholecystectomies and 15 in which cholecystotomies were performed, all between 1949 and 1953 at the Good Samaritan Hospital, Portland, Ore.

Cholecystectomy and common duct exploration were performed in 62 cases. Common duct stones were found in 19, or 30 per cent, of these cases. Common duct exploration without cholecystectomy was performed in 13 cases and stones were found in 6. Reoperation was performed on 16 patients, and stones were found in 4. Four patients entered the hospital during the above period for repair of an injured common duct.

Of the 259 patients, 80, or 31 per cent, had common duct exploration. Preoperative x-ray studies were made in 52 of the 80 cases, operative cholangiograms in 13, and postoperative cholangiograms in 57.

The author believes that operative cholangiography, despite definite problems, is an aid in preventing retained common duct stones and needless common duct exploration.

Seven roentgenograms; 1 drawing; 6 tables.

R. F. LEWIS, M.D.
Cleveland Clinic

THE MUSCULOSKELETAL SYSTEM

Primary Reticulum Cell Sarcoma of the Bone. Report of 44 Cases. Kenneth C. Francis, Norman L. Higinbotham, and Bradley L. Coley. Surg., Gynec. & Obst. **99**: 142–146, August 1954.

The authors have added 8 cases of primary reticulum-cell sarcoma of the bone to their previously reported series of 37 (Coley *et al.*: Radiology **55**: 641, 1950). Since 1 of the earlier cases proved, at autopsy, to be Ewing's sarcoma, the total series now numbers 44. The criteria used for inclusion are: (1) clinically, a primary focus in a single bone on admission; (2) unequivocal histologic proof from the bone lesion; (3) metastases present on admission only if regional or if onset of primary lesion preceded metastases by six months or more.

The authors stress the difficulties in diagnosis, the lesion often being difficult to differentiate from Ewing's tumor and metastatic neuroblastoma. The fact that the long bones are involved twice as often as the bones of the trunk aids in differentiation from generalized reticulum-cell sarcoma, in which the reverse is true. Patients with reticulum-cell sarcoma of bone usually complain of pain and initially are in apparent good health (considering the extensive nature of the disease), compared to those with Ewing's sarcoma and neuroblastoma.

All but 1 of the 8 new patients were treated with irradiation in doses ranging from 3,090 to 8,010 r. Coley's toxins were also given, and amputation was done in 2 cases.

The five-year survival for 32 patients (1925–48) was 48.4 per cent. The ten-year survival (based on 32 patients) was 33.3 per cent. In the recent series of 8 cases, there were 5 deaths, including the 2 cases with amputation; 2 patients were alive with disease, and 1 was free of evidence of disease after thirteen months.

It is pointed out that metastases or recurrences may develop after five or ten years of apparent freedom from disease. The authors conclude that irradiation supplemented by one or more courses of Coley's toxins is the treatment of choice. Amputation is not indicated except for complications.

One roentgenogram; 2 photographs; 3 tables.

HAROLD L. ATKINS, M.D.
University of Pennsylvania

Osteoid Osteoma. Balu Sankaran. Surg., Gynec. & Obst. **99**: 193–198, August 1954.

The author presents 32 cases clinically diagnosed as osteoid osteoma at the New York Orthopedic Hospital; in 21 the diagnosis was pathologically confirmed and in 8 the weight of clinical signs, roentgen appearance, and relief following surgery made no other diagnosis tenable. In 3 cases the pathological impression was that histologically the lesion was similar to but distinct from osteoid osteoma.

Osteoid osteoma consists essentially of a small nidus of osteoid tissue and newly formed bone trabeculae developing in the spongiosa and in relation to the cortex of the affected bone. Surrounding the nidus there is usually (30 of 32 cases in this series) a dense osteosclerosis. The lesion has been found in all bones of the body except the mandible and skull. It has a predilection for the lower extremity (27 of 32 cases in this series, including the pelvic girdle) and is found in a high proportion in the tibia (15 of 32 cases). Trauma has been considered an etiologic factor, but only 14 of the present series gave a history of trauma and in only 3 of this number did the trauma antedate the symptoms from the lesion.

Pain is the outstanding symptom (30 of 32 cases in this series). The constant physical finding was swelling of the involved bone, usually with exquisite point tenderness.

The condition is seen usually in adolescence. The average age in this series was 11.8 years. Twenty-seven of the patients were males.

Roentgenologically, the classical picture is a dense osteosclerosis with a centrally placed translucent area or zone 2 to 15 mm. in diameter. (In a lesion of the ilium in this series the nidus was almost an inch in diameter.) The nidus may be hidden by the dense osteosclerosis, and body-section roentgenograms may be required to establish its presence. Periosteal proliferation and reactive osteosclerotic changes in neighboring bones may occur. Irregular foci of calcification may often be seen in the area of the nidus,

which may be either cortical, intramedullary, or subperiosteal. No case of polyostotic lesions was reported in this series.

To be differentiated are Garré's sclerosing ostomyelitis, Brodie's abscess, syphilitic and tuberculous osteitis and osteomyelitis, fibrous dysplasia, and eosinophilic granuloma.

Treatment consists in surgical excision of the nidus, the complete removal of which is best insured by roentgenography at the time of operation.

Eleven roentgenograms; 1 photograph; 4 photomicrographs.

THEODORE A. TRISTAN, M.D.
University of Pennsylvania

Cystic Tuberculosis of the Bones in Children. Report of Two Cases. Althea D. Kessler, Roland B. Scott, Charles H. Kelley, and Ruth Steinman. Am. J. Dis. Child. **88:** 201–209, August 1954.

Though less common than tuberculous osteomyelitis with early caseation and abscess formation, there has been observed a form of tuberculosis presenting a cyst-like character on the roentgenogram. Fourteen cases have been recorded in the literature. Two cases are presented here.

These cystic lesions may show no activity for long periods, may break down with abscess formation or, more frequently, may heal without complication. Prognosis depends on involvement of vital organs. Complete healing of the bone lesions appears to take place over a long period and without residual deformity. In one of the authors' patients, with a solitary cystic area in the humerus, healing took place without any specific therapy. The bone lesions in the other patient, involving the skull, vertebrae, and long bones, healed in a one and one-half year period with Streptomycin, PAS, and Isoniazid, while the associated pulmonary disease persisted essentially unchanged.

Eleven roentgenograms; 2 photographs.

H. G. PETERSON, JR., M.D.
New Britain, Conn.

Pellegrini-Stieda's Disease. Report of 6 Cases. A. Ross Davis, George V. Miller, and Edward T. Smith. Texas State J. Med. **50:** 608–612, August 1954.

Pellegrini-Stieda's disease, or periarticular ossification of the tibial collateral ligament, is a relatively rare condition. The authors report 6 cases seen at Hermann Hospital, Houston, Texas. The disease is characterized by a deposit of calcium or bone just over the medial femoral condyle. Most patients give a history of trauma to the knee, usually when it is flexed and the leg is externally rotated. The trauma may be a single acute episode or of the repeated type. Roentgen examination establishes the diagnosis. A narrow space usually separates the lesion from the adductor tubercle. Characteristically, a crescent-shaped area of calcification is directed vertically or obliquely in the soft tissues just medial to the inner condyle of the femur and appears to cap the epicondyle. [For a more complete description of the roentgen findings, see Russell and Smith: Radiology **46:** 351, 1946.]

Five roentgenograms; 1 photomicrograph.

The Cervical Spinal Canal in Intraspinal Expansive Processes. Erik Boijsen. Acta radiol. **42:** 101–115, August 1954.

The author measured the sagittal diameter of the cervical spinal canal of 200 normal subjects and presents his results in detail. The changes to be expected in the presence of expansive tumors of the cervical spinal canal are:

1. Excavation of the dorsal surface of the vertebral body.
2. Erosion of the dorsal part of the laminae. In lateral views this is seen as a decrease in the length of the spinous processes.
3. Pressure atrophy in the other parts of the ring.

In a series of 13 cases of intraspinal expansive processes of the cervical spinal canal, skeletal changes were seen in 7.

Nine roentgenograms; 2 photographs; 4 diagrams.

THEODORE E. KEATS, M.D.
University of California, S. F.

Skeletal Changes in Teratomas of the Sacrococcygeal Region. E. Goetsch. Fortschr. a. d. Geb. d. Röntgenstrahlen **81:** 166–173, August 1954. (In German)

Next to the ovary and testis, teratomas are commonest in the sacrococcygeal region, where they may be either presacral or postsacral. Other localizations are: brain, spinal canal, heart, mediastinum, retroperitoneum, rectum, uterus, bladder, neck, and thigh musculature.

Two cases are reported, with clinical, pathologic, and radiologic findings.

The first patient, a newborn infant, showed a broad-based soft-tissue shadow contiguous with the sacrococcyx, containing calcification. Sections of the removed mass showed it to be a meningomyelocele, with some components suggesting a choroid plexus. About a year later the child was again seen because of a rapidly growing tumor over the left half of the sacrum. Radiologic examination at this time disclosed partial collapse of the fourth and fifth lumbar vertebral bodies and increase in calcification below the sacrum. Pathologic studies showed a malignant teratoma.

The second patient, an adult male, showed roentgenologically a large defect on the right side of the sacrum and coccyx and beneath this a soft-tissue shadow. Histologic studies disclosed a dermoid cyst with a squamous-cell epithelioma in its wall. No invasion could be demonstrated in the surrounding bone.

Five roentgenograms; 4 photomicrographs.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Osteitis Pubis. Leonard J. Alperin and Martha J. Bender. Am. J. Dis. Child. **88:** 227–233, August 1954.

Osteitis pubis, an idiopathic, self-limiting, non-suppurative osteonecrosis of the pubic bones, is rare in children. A case in a 6-year-old Negro boy is presented. Trauma, infection, and a combination of both have been implicated as etiological factors. Clinical manifestations include regional pain and local tenderness and spasm of the rectus and thigh adductor muscles. The patient cannot stand or sit in comfort and usually lies with the thighs flexed on the abdomen. Pain may radiate to the perineal area, causing contraction of the levator muscle group and precipitating painful micturition and defecation.

Roentgenographically there is progressive symmetrical decalcification of the bodies of the pubic bones, beginning at the symphysis and extending into superior and inferior pubic rami. Osteolytic activity progresses for four to six weeks, followed by gradual recalcifica-

tion. Complete resolution occurs within a year, often with ankylosis of the symphysis and infrequently with hyperostosis of the pubic bones. Microscopically there is evidence of subacute and chronic inflammatory reaction.

Treatment is non-specific, for the most part symptomatic, consisting largely of bed rest, immobilization, and physiotherapy.

Six roentgenograms. H. G. PETERSON, JR., M.D.
New Britain, Conn.

GYNECOLOGY AND OBSTETRICS

Free Gas in the Fetal Vessels as a Roentgenologic Sign of Intra-Uterine Fetal Death. Olov Fr. Holm. Acta radiol. **42**: 116–120, August 1954.

Free gas in the fetal vessels may be regarded as an additional sign of fetal death and maceration. This is an unusual sign, the author having been able to find only 5 cases described in the literature. He presents an additional case in which the diagnosis of intra-uterine death was established through demonstration of gas in the arterial system of the fetus.

The following explanation of the origin of the gas is presented as "conceivable." When the hemoglobin breaks down, its oxygen-absorption capacity is abolished. If this breakdown takes place rapidly, it is possible that so much oxygen is liberated that it cannot physically dissolve in the available, unmoving blood fluid but collects in the vessel as free gas. It is also possible that this is supported by a vacuum effect caused by shrinkage of the fetus, in which case large arteries are probably the only cavities in the flaccid fetal body with sufficient rigidity in the walls for the vacuum effect to act upon.

[In addition to the 5 cases cited by the author from the literature, Crick and Sims have reported 7 cases of their own and cited a number of others published and unpublished (J. Fac. Radiologists **5**: 126, 1953. Abst. in Radiology **63**: 779, 1954).—Ed.]

Three roentgenograms.

THEODORE E. KEATS, M.D.
University of California, S. F.

THE GENITOURINARY SYSTEM

Abdominal Aortography in Urological Diagnosis. Josef Fischer and Jan Kučera. Acta radiol. & cancerol. bohemoslov. **8**: 70–80, March 1954. (In Czechoslovakian)

The advantages, indications, and contraindications of aortography in urological practice are described in detail. The technic and the essential factors of differential diagnosis are discussed. Typical pictures of normal kidneys, polycystic kidneys, hydronephrosis, renal tumor, and tuberculosis are reproduced.

Eleven roentgenograms; 11 drawings.

E. A. SCHMIDT, M.D.
Denver, Colo.

Fatal Reaction Following Aortography with Neo-Iopax. A. J. Josselson and Joseph H. Kaplan. J. Urol. **72**: 256–260, August 1954.

A 35-year-old woman complained of headache and palpitation. Hypertension of 200/120, moderate sclerotic changes in the optic fundi, low specific gravity of urine, and 2+ albumin were the only significant findings. Urographic study with 20 c.c. of 50 per cent Neo-Iopax was performed without difficulty and revealed a non-functioning left kidney with compensatory hypertrophy of the right.

Prior to doing a left nephrectomy, aortography with 15 c.c. of 75 per cent Neo-Iopax was undertaken. A translumbar approach was used and the needle tip appeared to lie in the interspace between L-1 and L-2. No immediate difficulties of any sort were noted, but twenty-four hours later nausea and vomiting occurred. Myalgia and facial edema were also present. Because of the persistence of symptoms, the patient was hospitalized five days later. Oliguria, hematuria, and a blood non-protein nitrogen of 120 mg. per cent were found. The course was progressively downhill; the non-protein nitrogen rose to 580 mg., and death ensued.

Autopsy revealed pleural and pericardial effusions with cardiac enlargement. The left kidney was typical of chronic pyelonephritis. The right kidney showed numerous small cortical abscesses, areas of infarction, and hemorrhages. Various degrees of tubular destruction and regeneration were present. The findings suggested a severe toxic reaction. The possibility that it was due to a large concentration of medium in the right kidney, as shown on the aortogram, is considered. This may be attributed to absence of circulation in the left kidney and perhaps to the fortuitous placement of the needle in the aorta exactly opposite the lumen of the right renal artery. An allergic basis is also mentioned.

One roentgenogram; 2 photographs; 1 photomicrograph. W. WILLIAM NAGLE, M.D.
University of Pennsylvania

On the Tolerance of the Rabbit's Kidney to Contrast Media in Renal Angiography. A Roentgenologic and Histologic Investigation. Hans Idbohrn and Nils Berg. Acta radiol. **42**: 121–140, August 1954.

Two Umbradil preparations, in 50, 35, 25, 17.5, and 10 per cent concentrations, were used in an investigation of the tolerance of the rabbit's kidney to the contrast medium in renal angiography. In many of the animals a concentration of 17.5 per cent or more in the renal artery produced toxic injury of the kidney with exudation and degeneration, especially of the tubules. Above this critical level, the extent and severity of the damage were not found to be correlated with concentration of the medium. This absence of any definite relationship between the severity of renal injury and the concentration argues against a direct toxic effect on the epithelial cells, and for a more complex cause. The pathologic changes were, as a rule, reversible.

The damage observed in the rabbit's kidney suggests that caution should be exercised in the employment of renal angiography. Two factors should be borne in mind:

(1) Methods permitting the deposition of a contrast medium of a concentration intended for the aorta directly into the renal artery must be risky, because the contrast medium in the kidney then exceeds non-toxic concentration.

(2) Observations in the experiment suggest that, if renal angiography is repeated at short intervals, damage to the kidney may be produced by a quantity of contrast medium too small by itself to cause renal injury.

Five roentgenograms; 7 photomicrographs; 4 tables.

THEODORE E. KEATS, M.D.
University of California, S. F.

Papillary Adenocarcinoma of the Kidney, with Aortography Resembling Huge Renal Cyst. Benjamin L. Salvin and Walter A. Schloss. J. Urol. **72:** 135–140, August 1954.

A 61-year-old white male had a mass in the right flank for about eighteen months. Clinically this was believed to be a large right renal cyst. Excretory urography revealed no function in the right kidney. Retrograde studies showed medial displacement of the upper right ureter and kidney with distortion of the right renal pelvis and calyces. Aortography disclosed marked displacement of the aorta to the left, with a paucity of blood vessels in the right renal mass. It was believed that the findings were typical of a large cyst.

At operation, a tumor with a necrotic center was removed. Pathological diagnosis was papillary adenocarcinoma of the kidney. The patient subsequently died of metastases.

The authors believe that, because of the extensive and rapid growth of the tumor, massive necrosis and hemorrhage ensued, with lack of blood supply, causing renal arteriography to give the appearance of renal cyst rather than a neoplasm.

Three roentgenograms; 1 photomicrograph; 1 photograph.

W. WILLIAM NAGLE, M.D.
University of Pennsylvania

Roentgen Diagnosis of Carcinoma of the Ureter. S. Petković. Fortschr. a. d. Geb. d. Röntgenstrahlen **81:** 157–166, August 1954. (In German)

The author divides tumors of the ureter as follows: (*a*) primary tumors, including the benign epithelial tumors (papilloma), the malignant epithelial tumors (carcinoma), and the rare mesenchymal tumors; (*b*) secondary tumors, including those from the kidney pelvis through implantation, metastatic tumors, and tumors invading from surrounding organs.

Hematuria, pain, and presence of a mass (the enlarged kidney rather than the ureteral tumor itself) is the triad that should arouse the clinical suspicion of ureteral cancer.

Intravenous pyelography, in spite of its usefulness in demonstrating the condition of the kidney, will reveal the ureteral lesion in only 5 per cent of the cases. Sole dependence upon this examination may lead to the wrong therapy (nephrectomy and partial ureterectomy instead of a total nephro-ureterectomy). Retrograde ureteropyelography is the diagnostic method of choice, but even with this, the tumors may be missed.

The positive ureteral findings as observed by the author in a series of 100 cases, were as follows: (1) Complete obliteration of the ureter. The ureter distal to the obstruction is of normal appearance, a differential point against tuberculosis.

(2) Stenosis of the ureter. This can be annular (ring-like or up to 4 cm.) or irregular.

(3) Filling defects, either round or oval, with regular contours. If the contrast material can be made to surround the filling defect completely, this is an indication that it is benign. However, when the filling defect is irregular, with indistinct contours, malignancy is suggested. Extensive filling defects with only a small amount of contrast material visible suggest carcinosis.

Seventeen cases are described, 15 including x-ray reports.

[This abstracter finds fluoroscopy with spot films of great aid in studying the ureter and the kidney during the retrograde examination.—C.V.C.]

Twelve roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

THE DIAPHRAGM

Congenital Eventration of the Diaphragm. Oliver E. Laxdal, Hector McDougall, and Gilbert W. Mellin. New England J. Med. **250:** 401–408, March 11, 1954.

Eventration of the diaphragm may occur as a result of trauma, with sudden marked increase in intra-abdominal pressure. In most cases, however, there is a congenital basis, a predisposing factor usually being present in the post-traumatic cases. The incidence is roughly 1 in 10,000 individuals. Bilateral eventration has been described in a single instance.

Pathologically a great variation can be seen in the degree of muscle deficiency in this condition. All degrees exist from slight thinning out of the entire diaphragm to complete absence of the fibers with only a thin, translucent aponeurotic sheet remaining. Associated congenital abnormalities are frequently observed, notably abnormal mesenteric attachments in the gastrointestinal tract.

About half of the patients are asymptomatic. Symptoms in the remainder vary from mild difficulty to severe cardiovascular and respiratory embarrassment. Cyanosis, dyspnea, and tachycardia during the first few weeks of life may be manifested. More chronic symptoms in the adult include a sense of fullness and distress after meals, cough with epigastric pain, shortness of breath after exertion, pain radiating into the arm, and severe hiccups.

The diagnosis is made on x-ray examination. Fluoroscopically and on film studies, the diaphragm is seen to form a round unbroken line arching from the mediastinum to the costal margin. The affected leaf rises high into the chest. The type of diaphragmatic movement may be observed fluoroscopically. If synchronous motion is present, the possibility of a phrenic nerve lesion can probably be excluded. Pneumoperitoneum may be considered to differentiate a diaphragmatic hernia but an exploratory laparotomy is probably to be preferred, the surgeon being prepared to repair either a hernia or eventration. Use of contrast media in the stomach and colon is also of benefit.

Surgical plication is indicated in newborn infants who suffer acute episodes as a result of eventration. If possible, postponement of surgery until the patient is about one year old is advised. In adults, surgery should be undertaken only to decrease symptoms and must be related to the degree of disability caused by the disorder. The authors present two detailed case studies to illustrate their discussion of this subject. The technic of surgical repair is considered.

Three roentgenograms; 5 drawings.

E. E. TENNANT, M.D.
Sterling, Colo.

MISCELLANEOUS

Radiography Prior to Emergency Laparotomy. Ls. Ivan Vallée. J. Canad. A. Radiologists **5:** 26–27, June 1954.

This is a general discussion on the evolution of a

program of routine radiographic examination of the abdomen and lower chest in patients who are prospects for emergency laparotomy, exclusive of traumatic cases.

These studies have revealed enlarged kidneys and spleens, foreign bodies, renal stones, pneumoperitoneum, and bowel obstruction, all of which were unsuspected clinically. The partial study of the chest may reveal pulmonary or cardiac disease.

The films also serve as a useful reference postoperatively.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

Roentgen Changes Observed in Generalized Scleroderma. Report of Sixty-Three Cases. Joseph A. Boyd, Simmons I. Patrick, and Robert J. Reeves. Arch. Int. Med. **94**: 248–258, August 1954.

Sixty-three cases of scleroderma, seen at Duke Hospital, Durham, N.C., during the past twenty years, have been reviewed, with emphasis on the roentgen findings. Forty-three of the patients were females and 20 were males; 47 were white and 16 Negro; the majority (67 per cent) were in the thirty-one- to fifty-year age group. Fifty-seven patients had one or more roentgen examinations, with 45 showing one or more of the changes which have been described as occurring in scleroderma.

Chest: A chest roentgenogram was taken in 54 patients, and in 24 (44 per cent) the lung fields showed some abnormality. The predominant change was an interstitial-like infiltrative process in the central portions of both bases, tending to clear partially and then recur, with increased distribution upon each recurrence. As the disease progressed, the pulmonary lesion became more widespread and a definite permanent, progressive fibrotic component became readily recognizable. In 2 cases large pneumoceles were seen, with subsequent development of pneumothorax.

In 22 cases (40 per cent) cardiac hypertrophy, which was believed to be related to the disease process, either primarily or secondarily, was found. The heart configuration was rather globular, owing to generalized enlargement.

Gastrointestinal Tract: Of the 29 cases investigated radiologically, 23 (79 per cent) showed changes in the esophagus, ranging from abnormality of transit time to a markedly abnormal appearance. In some cases there was a pronounced narrowing of the sphincter area, with dilatation, loss of tone, absence of peristaltic activity, and marked retention of barium. Examination in some cases disclosed a generally narrow esophagus with rigid walls. The esophagus emptied only by gravity and showed absence of mucosal pattern. Whenever the stomach and small bowel were examined, abnormality in these organs was noted as well. The stomach appeared flaccid, with marked delay in emptying. Small bowel studies, in 4 patients, revealed abnormality of segmental width and a neuromuscular disturbance. No abnormalities of the colon were observed.

Bones: The phalanges of the hand were examined in 31 cases. In 18 (59 per cent) there were varying degrees of sclerodactyly, from partial resorption of the ungual tuft of one phalanx to almost complete resorption of the terminal phalanges of all fingers of the hand. All these cases demonstrated that the resorption of bone originates from the distalmost point and progresses proximally. Resorption of the bone was accompanied by acrosclerosis or by large swollen fingers in which severe vascular disturbances and marked proliferative changes were present, interfering with the blood supply.

Soft Tissues: Roentgenograms of the hands, in 27 of 31 cases (87 per cent), revealed definite abnormality of the soft tissues, consisting of swelling or atrophy. In some cases calcium deposits occurred. One of the characteristic early findings was a multiplicity of linear changes of decreased density. The acrosclerotic fingers showed atrophy. In both types there were linear streaks of decreased density, much greater than in normal fingers. In several cases there was diffuse atrophy of the shoulders and chest wall, with calcium deposits which were both subcutaneous and intramuscular. Raynaud's phenomenon was observed in approximately half the cases with soft-tissue change.

Joints: Roentgenograms of various joints in 31 cases disclosed no abnormality in 14 and changes resembling rheumatoid arthritis in 17 (54 per cent).

Liver and Spleen: Thirteen of 24 roentgenograms of the abdomen showed the liver or spleen to be enlarged. Liver enlargement may be primarily the result of right heart failure with congestion. Congestion may also be responsible for the splenic enlargement. In at least 2 cases the spleen was grossly enlarged and the liver shadow was of normal size.

Miscellaneous: Many cases showed pleural change. In 2 cases which came to necropsy there was pericardial involvement; in these 2 cases arteriosclerosis, arteriolar sclerosis, and arteriolar necrosis were present to a prominent degree.

Seventeen roentgenograms; 3 tables.

Tumor Development following War Injury (Adenocarcinoma of Rectum and Malignant Synovioma). G. Busch. Strahlentherapie **94**: 547–553, August 1954. (In German)

This is an interesting contribution to the problem of the relationship between trauma and tumor. To prove a traumatic origin of a tumor, the author postulates that the following criteria have to be present: (1) proof of a severe trauma; (2) development of the tumor at the site of the trauma; (3) evidence of tissue activity in the affected area during the interval between the injury and the diagnosis of tumor. To illustrate these criteria, 2 cases are reported.

A 22-year-old male suffered a shrapnel wound of the sacral region, with injury to the rectum and anus. Parts were surgically removed, and a permanent colostomy was done. During an interval of thirty-three years this patient had fistulas with intermittent drainage and abscess formation. Finally a large adenocarcinoma developed in the area, extending upward into the fistulous tracts.

The second patient, a 19-year-old male, suffered a shrapnel wound of the right forearm 10 cm. below the elbow joint, with injury to the radius and ulna. During a period of five years there was activity of the wound with fistula formation, intermittent drainage, and occasional extrusion of sequestra, until a soft-tissue swelling was noted. A biopsy of this tumor revealed a malignant synovioma. The arm was amputated, but the patient died two years later from multiple metastases.

Two roentgenograms; 2 photographs; 1 photomicrograph; 1 drawing.

EUGENE F. LUTTERBECK, M.D.
Urbana, Ill.

The Use of Wire Markers in Cooper's Ligament Hernia Repairs with Roentgenologic Studies. Report of Seventy-two Hernioplasties. Hilding H. Olson, Edmund A. Kanar, and Henry N. Harkins. Surgery **36**: 270–277, August 1954.

The authors utilized wire markers to detect roentgenographically separations of coapted fascial layers following herniorrhaphy in a series of 72 Cooper's ligament hernioplasties. In the total number, there were 10 instances of wire marker separations, only 1 of which (10 per cent) was associated with a recurrence of a hernia. In 2 cases of recurrence (3 per cent) there was no evidence of separation of the markers, and in 9 patients displacement of the markers was not associated with clinical evidence of recurrence There thus appears to be a slight but statistically insignificant correlation between the clinical recurrence of a hernia after its repair and the separation of wire markers inserted at the time of operation.

Six roentgenograms; 1 table.

THEODORE E. KEATS, M.D.
University of California, S. F.

RADIOTHERAPY

The Influence of Radium on Cancer Therapy. Douglas Quick. Canad. M. A. J. **71**: 103–109, August 1954.

Some recent experiences with telecurie therapy are related. It is the author's belief that irradiation with superior quality beams offers a definite advantage, particularly in the treatment of cancers of the lung, esophagus, urinary bladder, and prostate. Other favorable usages appear to be in building up lateral pelvic doses in female pelvic cancer and the more efficient irradiation of axillary and internal mammary lymph node involvement. Certain cases of intra-oral cancer with metastatic cervical nodes which are no longer encapsulated and bone lesions associated with epidermoid carcinoma in the mouth are other examples cited.

Treatment with supervoltage sources, which include, in addition to radium, cobalt 60 and 2-Mev x-rays, is thought to offer the following advantages: (1) increased curability with less shock and deforming disability, particularly in the more resistant major groups of malignant disease; (2) greater long-term palliation; (3) more effective short-term palliation. A plea is entered for more enlightened radical surgery and an earlier submission of frankly inoperative patients to radiotherapeutic methods.

The incongruity of binding the reporting of cancer results to the "five-year cure" statistical evaluation is pointed out. It is suggested that some attempt be made to state the degree and duration of worth-while palliative effects in patients treated for advanced lesions.

The report includes photographs and diagrams of telecurie radium beam apparatus with radioautographs of the convergent beam pattern at various depths.

J. W. BARBER, M.D.
Cheyenne, Wyo.

Planning a Clinical Trial of Radiotherapy for Intracranial Gliomata. John Penman. Proc. Roy. Soc. Med. **47**: 677–680, August 1954.

The author analyzes the factors involved in answering the question: "Suppose a patient to have an intercranial glioma for which he undergoes operation; what difference will it make to the length of his life after operation if he is irradiated as well?" Among the many variables pertinent to an analysis of the problem, nine major points are discussed: (1) uniformity of surgical method; (2) strictness and uniformity of histologic diagnosis. (3) exclusion of unsuitable forms of glioma (such as medulloblastoma and ependymoma for reasons of high radiosensitivity, and cerebellar astrocytoma, which can be completely excised); (4) a moderately simple classification of cases (there are 44 ultimate subdivisions based on sex, age at operation, and extent of surgery, with histology when available); (5) uniformity of starting point for measurement of survival; (6) a fixed minimum period of survival for inclusion in the series (56 days); (7) a simple method of determining whether a given patient shall be irradiated or not (non-irradiated controls are run); (8) comparative uniformity of methods of radiotherapy; (9) uniformity of follow-up.

The author cannot state the results of his study, as sufficient time has not yet elapsed since its institution.

Four tables.

C. M. GREENWALD, M.D.
Cleveland Clinic

Carcinoma of the Paranasal Sinuses and the Nasal Cavities. A Clinical Study of 379 Cases Treated at Radiumhemmet and the Otolaryngologic Department of Karolinska Sjukhuset, 1940–1950. Lars-Gunnar Larsson and Gunnar Mårtensson. Acta radiol. **42**: 149–172, August 1954.

The present investigation relates to 379 cases of carcinoma of the paranasal sinuses and nasal cavities, seen from 1940 to 1950. The age distribution, predisposing factors and symptomatology of the patients studied are presented. The most frequent early symptoms (pain, nasal secretion, and obstruction) are identical with the symptoms of sinusitis. Roentgenograms characteristically show bone destruction, but this is not an early sign. For these reasons, chronic sinusitis should not be treated conservatively over a long period, but tissue material should be obtained and studied histologically.

For treatment, a combined electrosurgical and radiologic approach has been used for operable cases and a purely radiologic approach for inoperable cases. Absolute contraindications to surgery were roentgenologically demonstrable destruction of the base of the skull or of the pterygoid process, tumor infiltration of the mucous membrane of the nasopharynx, inoperable lymph node metastases, and generalized metastases.

Two types of radiotherapy were used, roentgen irradiation and insertion of radium according to Berven's technic (Am. J. Roentgenol. **28**: 332, 1932). Roentgen therapy is given, as a rule, over four rectangular facial fields, two medial and two lateral, with the beam directed through the center of the tumor. Factors are 180 kv, 0.5 mm. Cu or a Thoraeus filter, 50–60 cm. target-skin distance. One field is treated daily with a dose of 400 to 500 r, measured on the skin. The optimal tumor dose would appear to be approximately 6,000 r in thirty days in the event of

radiotherapy alone. This usually requires approximately 3,000 r skin dose per field.

The other type of radiologic treatment consists of local insertion of radium tubes in the operative cavity in conjunction with electrocoagulation. As a rule, four tubes, 10 × 5.4 mm., each containing 50 mg. radium, were used, with 0.35 mm. Al and 0.3 mm. Pt filtration. To increase distance they are fitted with an outer aluminum case 3 mm. in thickness. The duration of application varied from three to five hours.

The present principles of treatment call for close cooperation between the radiologist and otolaryngologist. Those cases which are considered operable receive preoperative irradiation in accordance with the above described technic, with 2,000 to 2,500 r per field, and are submitted to radical operation four to six weeks later. At the same time radium tubes are inserted in the operation cavity. More recently roentgen therapy has been given initially in full dosage, with resort to surgery only if symptoms recur.

The clearly inoperable cases and the borderline cases receive irradiation with about 3,000 r per field. Some of these may be rendered operable.

The following five-year results were obtained: Absolute five-year cure rate (based on 294 cases) 23 per cent; relative five-year cure rate, 27 per cent; for 114 surgically treated cases (electrocoagulation in combination with radiotherapy), 45 per cent; for 142 cases receiving radiologic treatment alone (largely inoperable cases), 12 per cent.

Three roentgenograms; 14 photographs; 3 diagrams; 13 tables. THEODORE E. KEATS, M.D.
University of California, S. F.

Treatment of Cancer of the Tongue with Irradiation. Anna Placherová. Acta radiol. & cancerol. bohemoslov. **8**: 111–119, May 1954. (In Czechoslovakian)

According to the classification of Sharp and Spickerman (Am. J. Roentgenol. **57**: 181, 1947. Abst. in Radiology **49**: 758, 1947) four stages are differentiated in cancer of the tongue:

Stage I: Tumor less than 1.5 cm. in diameter, and no involvement of lymph nodes.

Stage II: Tumor less than 3 cm. in diameter and no involvement of lymph nodes ascertainable.

Stage III: Primary tumor of Stage I or II, with a movable node or group of nodes on the same side of the neck.

Stage IV: Primary tumor of Stage I or II, or larger, with lymph node involvement on the collateral side of the neck or on both sides; infiltrating or fixed nodes; evidence of invasion of neighboring tissues or of distant metastases; cachexia.

The advantages and disadvantages, technics, indications, and contraindications of the different radiotherapeutic procedures (interstitial radium therapy, telecurie therapy, and roentgen therapy), as well as of surgical intervention, are discussed not only with regard to the different stages of the disease but also in respect to the equally important location of the primary lesion (whether in the anterior two-thirds of the tongue or in the posterior third). In many cases, a combination of the different therapeutic agents is necessary for maximum benefit. In some instances a palliative effect is the best that can be expected.

E. A. SCHMIDT, M.D.
Denver, Colo.

Treatment of Laryngeal Carcinoma by X-ray Irradiation. Emil Ungár. Acta radiol. & cancerol. bohemoslov. **8**: 100–109, May 1954. (In Czechoslovakian)

In four explicit tables the essential factors in the x-ray treatment of laryngeal lesions are formulated. The tables, modified for anteroposterior and lateral irradiation fields ranging from 4 × 4 cm. to 8 × 8 cm., consider the following factors: positioning of patient, port and factors of entry, size and configuration of fields, distance between contralateral points, surface dose, tumor dose percentage, maximal and minimal sagittal diameters, double daily dosage, weekly dosage, skin dose percentage, double daily and weekly fractional dosage (in r). The individual data of the codification are explained and discussed in detail.

Six illustrations; 4 tables. E. A. SCHMIDT, M.D.
Denver, Colo.

Regional X-ray Irradiation of Cancer of the Breast. Emil Ungár. Acta radiol. & cancerol. bohemoslov. **8**: 49–59, March 1954. (In Czechoslovakian)

The author's method of roentgen irradiation of the breast is a modification of the original technic of McWhirter and Smithers in London and has been in use at the State University Hospital of Prague-Vinohrad for the last nine years. Generally, one large tangential portal, 24 × 10 cm., is used over the anterior mammary area, combined with clavicular fields (from 15 × 10 cm. to 20 × 10 cm.) and a posterior axillary field (8 × 10 cm.). In cases of breast amputation, a longitudinal field in the midclavicular line (4 to 6 cm. × 24 cm.) is added. In non-operated cases, 3 convergent treatment portals, 8 × 8 cm., are added to the nipple area at angles of 45 degrees. The technical factors are 200 kv., 0.5 mm. Cu + 1 mm. Al filtration, half-value layer 1.5 mm. Cu, distance 50 cm.

Twenty-one illustrations. E. A. SCHMIDT, M.D.
Denver, Colo.

Primary Carcinoma of the Vagina. Owen Millar. J. Canad. A. Radiologists **5**: 23–25, June 1954.

Seventy cases of vaginal carcinoma collected in a twenty-year period from the records of the Ontario Institute of Radiotherapy are reviewed. The staging is modified from that of the League of Nations for cervical cancer.

Stage I: Lesion not more than 3.0 cm. in diameter and confined to vaginal tube.

Stage II: Greater than 3.0 cm. in diameter, or spread to parametrium on *one* side but not to lateral wall of pelvis.

Stage III: Spread to both parametria or to one or both lateral pelvic walls.

Stage IV: As Stage III, with bladder, bowel, suprapelvic, or distant metastases.

Stage I lesions, according to present practice, are treated with a single plane radium implant which may be curved to conform to the natural curve of the vagina. The radium is full strength (0.66 mg./1. cm.) at the periphery and half strength (0.33 mg./1 cm.) at the center to increase peripheral dose and decrease central necrosis. The needles usually contain 1.0, 2.0, 1.5, and 3.0 mg. For Stages II and III, a radium implant is used, as for Stage I, if the disease is not too advanced. In advanced cases, a central radium source is applied to

deliver 4,000 r in one hundred hours, or 3,000 in forty-eight hours. This is followed by external irradiation to four pelvic ports.

The overall five-year survival rate for 52 patients treated up to 1948 is 29 per cent.

Two roentgenograms; 1 photograph.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

Rodent Ulcers: An Analysis of 711 Lesions Treated by Radiotherapy. Ian Churchill-Davidson and Ethel Johnson. Brit. M. J. 1: 1465–1468, June 26, 1954.

A total of 613 patients with rodent ulcer treated primarily by irradiation at St. Thomas's Hospital, London, were studied; 63 had more than one lesion, making a total of 711 treated lesions. Of these lesions, 69.2 per cent were ulcerative; 7.7 per cent were papular; 5.3 per cent were cystic; 10.5 per cent were of the plaque type; 5.3 per cent were superficial; and 1.4 per cent were pigmented. No lesions were included in which there was known involvement of bone or cartilage.

Radium was used in the treatment of 8 lesions. The remainder (703 or 98.9 per cent) were treated by x-rays. Some patients received a single dose of 2,000 to 3,000 r. Some were given a total of 3,500 to 5,000 r at the rate of one to two treatments a week over a period of one to three weeks. Others were irradiated three to five times a week for one to three weeks, receiving a total of 4,500 to 6,500 r, this last method being usually reserved for the larger lesions.

The cure rate for all lesions treated was 95.7 per cent at three years and 92.6 per cent at five years. There were 26 known recurrences, of which 8 were cured with further radiotherapy. As would be expected, these recurrences usually appeared within five years. Fourteen (53.8 per cent) of the recurrences occurred among the smallest lesions, showing that size is not a sure criterion for estimating the results to be anticipated. Radionecrosis occurred in 7 cases.

In assessment of the cosmetic results, the two critical factors appeared to be the depth and size of the lesion treated. The cosmetic results were excellent in 15.8 per cent, good (a pale scar, with no pitting, pigmentation, telangiectasia, or contraction deformity) in 76.5 per cent, fair in 5.8 per cent, and poor in 1.8 per cent.

Ten tables. DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Antithyroid Drugs Plus Roentgen Irradiation in the Treatment of Hyperthyroidism. Johannes Böe and Zeth Gabrielsen. J. Clin. Endocrinology & Metab. 14: 939–947, August 1954.

This study was made on the hypothesis that, accompanying the reduction in thyroid hormones when antithyroid drugs (exclusive of iodine) are used, an apparently highly active thyroid gland results and that the gland in this hyperactive state may be especially sensitive to x-rays. Reciprocally, it was thought that antithyroid drugs would be beneficial in the early period of treatment, since the effect of roentgen irradiation is rather slow.

A total of 140 patients were treated, of whom 115 were women. The age range was fifteen to seventy-nine years. The initial classification of hyperthyroidism was based on the basal metabolism rate. Diffuse goiters were present in 91 per cent, nodular goiters in 9 per cent. Twenty-four patients had had some form of previous treatment.

During the earlier part of the investigation, methylthiouracil (daily initial dosage 600 mg.) was used. Later, propylthiouracil (400 mg. daily initial dosage), and finally Tapazole (methimazole) (15 mg. daily initial dosage) was used. Twenty-nine patients received more than one drug. The initial dosage was carried for three weeks and then was gradually reduced. After an average of three months, the patient was placed on a maintenance dose. This varied, but as a rule was as follows: methylthiouracil, 100 to 200 mg. daily; propylthiouracil, 50 to 100 mg. daily; Tapazole, 5 mg. daily.

The total duration of treatment was five months to five years. For the 67 patients regarded as apparently cured, the average duration of treatment was 14.4 months. Complications of drug treatment encountered were: exanthema, nausea and vomiting, leukopenia, agranulocytosis. Fewer reactions occurred with propylthiouracil and Tapazole.

Roentgen treatment was given when clinical improvement became apparent, usually within four weeks, and when the basal metabolism rate was below 30 per cent. Two hundred to 300 r (air) was administered daily for nine consecutive days, the total dose being 1,800 to 2,700 r, depending on the size of the goiter. Factors were as follows: 175 kv, 4 ma, filter 2 mm. copper, distance 30 cm., three fields. The only reactions observed were local erythema and transient hoarseness.

The average period of follow-up, after discontinuance of treatment, for the group considered permanently cured was 15.9 months. Observations on the therapeutic response were made on 99 of the original 140 patients: 75 per cent showed a permanent remission (considered permanent if six months or more); 5 per cent showed improvement, and in 20 per cent treatment had to be given up because of untoward effects of the drugs, lack of cooperation, or recurrences.

The authors conclude that the addition of radiotherapy does not seem to lessen appreciably the period of treatment necessary to obtain a permanent remission of hyperthyroidism with drugs alone. They feel, however, that since it may possibly help to bring about a permanent remission, it may be used as an adjunct to antithyroid medication.

Ten tables. F. F. RUZICKA, M.D.
St. Vincent's Hospital, N. Y.

RADIOISOTOPES

Radio-Active Iodine (I^{131}) and Protein-Bound Iodine in Thyroid Disorders. J. P. Madigan and W. E. King. M. J. Australia 1: 801–814, May 29, 1954.

One hundred and fourteen patients received 140 tracer doses of I^{131}. The cases are divided into three groups: non-toxic goiter, hyperthyroidism, and hypothyroidism. In 128 of the 140 tests the clinical evaluation was correct. Physical indices were correct 113 times, inconclusive 6 times, and incorrect for 21 tests. Protein blood iodine (PBI) determinations were obtained 131 times and were correct in 111 instances, inconclusive in 13, and incorrect in 7.

An attempt to correlate the basal metabolic rate with the results of the tracer tests showed it to be a reliable basis of classification in only 40 of 76 cases.

A total of 23 patients with thyrotoxicosis were treated with I^{131}. The number of doses varied from one to four, the average dose being 7 mc., with a dosage range of 4 to 11 mc. In 10 patients the condition was controlled for periods of six months to three years. All patients except one improved initially with I^{131}.

In 10 cases I^{131} tracer tests were employed to determine whether or not a mediastinal mass contained functioning thyroid tissue. Uptake was significant in 6 cases.

The authors also gave therapeutic doses of I^{131} to 5 of 17 patients with thyroid cancer, but results were inconclusive.

This paper and two others (abstracted below) are the outcome of a joint study of radioactive iodine as a test of thyroid function, carried out at the Royal Melbourne Hospital, Australia.

Four tables.

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Jacksonville, Fla.

Thyroid Symposium. II. Protein-Bound Iodine as Diagnostic Aid in Thyroid Dysfunction. Dora Winikoff. M. J. Australia **1**: 859–865, June 5, 1954.

Various tests used in studying thyroid dysfunction do not concern the same area of physiologic disturbances. I^{131} uptake expresses the degree of avidity for iodine; PBI^{131} is dependent on the conversion of inorganic iodine to hormonal iodine and the rate of its release to the blood stream; the PBI value is the titer of hormonal iodine in the blood at any given time, while the basal metabolic rate is the result of the impact of thyroid hormone on the tissues.

For this study PBI tests were performed on 106 normal individuals, and 137 patients suspected of having thyroid disease. Most of the analyses were made concurrently with I^{131} tracer studies.

The 106 normal controls gave 101 (95 per cent) normal PBI values. The range was 2.7 to 8.0 micrograms per 100 ml. with a mean value of 5.16 micrograms.

In a group of 74 patients who had become euthyroid after treatment with antithyroid drugs, radioactive iodine, or surgery, 83 of 92 tests were within normal limits, *i.e.*, there was a 91 per cent agreement with the clinical diagnosis.

A third group of patients, numbering 40, were hyperthyroid. In 64 of 70 tests in this group the PBI range was from 7.5 to 20.6 micrograms per 100 ml., an agreement of 90 per cent. A group of hypothyroid subjects was also studied, but the cases were too few for statistical evaluation.

A serious limitation to the value of the PBI as an indicator of thyroid function is the effect of various medications. Some drugs cause a false elevation of hormonal iodine, while others suppress thyroid function. Those which cause a spurious rise are Lugol's solution, tincture of iodine, thyroid preparations, iodized salt, cough mixture, and opaque media for x-ray examination, such as Lipiodol, Priodax, Diodrast, etc. A pronounced drop in PBI values occurs with thiocyanate, mercurial diuretics, cortisone, and ACTH. Lipiodol may affect the PBI for several years. In 16 tests in which there were evidences of interfering medication, PBI values showed a range of 5.2 to 56.5 micrograms per 100 ml. for euthyroid patients and from 1.5 to 28.0 micrograms for those with hyperthyroidism.

In view of the large number of difficult and borderline cases in the material studied, the author regards the low percentage of misclassifications as proof that PBI estimation is a valuable aid in the diagnosis of thyroid dysfunction. The importance of performing several PBI tests on a day-to-day basis and averaging the results is stressed.

One illustration; 3 tables.

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Thyroid Symposium. III. The Use of Radioactive Iodine I^{131} in the Diagnosis of Hyperthyroidism: Physical Aspects. K. H. Clarke and R. L. Aujard. M. J. Australia **1**: 891–898, June 12, 1954.

This is a review of the various physical indices of thyroid function, such as the rate of accumulation of I^{131} in the thyroid, the proportion retained in the gland in twenty-four hours, and the proportion excreted in twenty-four hours. Practically every index chosen has a valid numerical value for frankly thyrotoxic patients and normal persons. The difficulty in assessment has been in the borderline values for normal persons and borderline hyperthyroid patients.

The most accurate physically measurable index appears to be the level of PBI^{131} in the plasma forty-eight hours after administration of a tracer dose of I^{131}, expressed as a percentage of the dose per liter.

A second index which has also been found very useful is the initial rate of uptake of I^{131} by the thyroid gland, as measured by the percentage of the dose accumulated by the gland fifteen to twenty-five minutes after intravenous administration of the tracer dose.

The toxic and non-toxic limits of these indices vary according to the region from which patients are drawn, and it seems necessary for each center to determine its own limits before using the technic as a routine aid to diagnosis. Neither of these indices is useful in the diagnosis of hypothyroidism.

A new technic is described which facilitates the determination of the I^{131} content of the thyroid, the I^{131} content of urine, and the level of plasma PBI^{131} by the use of tracer doses of 20 microcuries of I^{131}.

Two photographs; 8 graphs; 5 tables.

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Production of Iodine-132. L. G. Stang, Jr., W. D. Tucker, H. O. Banks, Jr., R. F. Doering, and T. H. Mills. Nucleonics **12**: 22–24, August 1954.

In some diagnostic applications the physical properties of I^{132} may provide some advantages over I^{131}. The former has a half-life of 2.33 hours as compared with the eight-day half-life of the latter. The beta particles and gamma rays of I^{132} also have higher energies than those of I^{131}. Two consequent advantages are the avoidance of the problem of waste disposal and the opportunity to repeat tests more frequently.

I^{132} is formed in the decay of Te^{132}, which has a half-life of seventy-seven hours. I^{132} is therefore conveniently available, since the relatively long half-life of the parent isotope simplifies shipping and handling problems.

The authors have developed a complete unit containing Te^{132} in which the I^{132} can be produced. This unit can be conveniently shipped and remotely operated. Figures illustrating its components are presented, and details of the procedures employed to dissolve the Te^{132}

and its decay product and reprecipitate it, allowing the active iodine solution to be filtered off, are given. Enough tellurium can be charged into the generator so that there will be about 1 curie of Te^{132} present when the shipment is received. Such a unit would provide 10 microcuries of I^{132} over a period of fifty-four days.

Analysis of numerous decay curves permits the authors to state a half-life of 2.33 ±0.02 hr.

Five figures; 1 table.

JOHN S. LAUGHLIN, Ph.D.
Memorial Center, New York.

Radiochromium-Labeled Erythrocytes for the Detection of Gastrointestinal Hemorrhage. Charles A. Owen, Jr., Jesse L. Bollman, and John H. Grindlay. J. Lab. & Clin. Med. **44**: 238–245, August 1954.

Erythrocytes labeled with radioactive chromium (Cr^{51}) were studied in the blood and gastrointestinal tract of the dog in an attempt to find a better method of evaluation of gastrointestinal bleeding than we now have with the usual chemical methods. The authors found that hexavalent chromium, which alone is able to label the erythrocytes, should be used for this experiment. The trivalent chromium ion, they state, is bound selectively to the plasma proteins.

Since detection of the radioactivity is not difficult with sensitive gamma-ray counters, the method would appear to be useful as a means of detecting blood in the feces. The studies indicate that in man labeling of the patient's circulating erythrocytes should allow qualitative detection and approximate quantitation of gastrointestinal bleeding. Genitourinary bleeding might be measured by the same method, although probably with less precision, since the urinary excretion of Cr^{51} in the dog exceeded the fecal excretion by somewhat more than tenfold.

Two graphs; 6 tables. C. E. DUISENBERG, M.D.
Palo Alto, Calif.

Thyroid Carcinoma. An Approach to Management of the Disease. G. L. Scholnick, G. Arnold Stevens, and J. M. Beal. California Med. **81**: 72–75, August 1954.

A clinical and pathological study was made of a series of 34 consecutive patients with thyroid carcinoma who were observed at the VA Center, Los Angeles, between 1940 and 1953. Thirty of the patients were men. The youngest was nineteen and the oldest seventy-one years of age; the average age was forty-three years. All 34 patients had nodular goiters. Only 5 nodules were described as being unusually hard. Only 1 patient had symptoms of hyperthyroidism.

Since radioiodine became available in 1949, each patient has been given a diagnostic tracer dose of 1 to 2 microcuries I^{131} to determine the functional activity of the thyroid. Following this test, doses of between 200 and 300 microcuries of I^{131} were administered in order to obtain a scintigram of the neck, the amount given depending on the maximum uptake of the tracer dose. In 5 of 6 patients with thyroid carcinoma studied preoperatively by this procedure, an area of decreased function was demonstrated at the site of the neoplasm. Four to six weeks following thyroidectomy, radioiodine was again administered to determine if functional thyroid tissue remained in the neck.

In 4 patients with far advanced thyroid cancer, no surgery was performed; all died within three years.

Partial thyroidectomy was done in 13 patients; 10 of this group are alive, and of 5 followed five years or longer, none had recurrence. The other 3 patients died within five years from recurrent carcinoma.

Total thyroidectomy was performed in 7 patients. Although all were alive at the time of this report, only 1 had been observed for a period of five years. In that case there had been no recurrence. Metastases developed in 2 patients with solid carcinoma.

Thyroid lobectomy and radical neck dissection was carried out in 5 patients. Four remained alive without recurrence, but in only 1 was the follow-up more than five years. One patient died four years postoperatively of metastases.

Five patients underwent total thyroidectomy and radical neck dissection. All were alive at the time of the report, but only 1 had been observed for as long as five years, and in that case a recurrence was present in the neck.

The authors believe that solitary thyroid nodules are best treated by lobectomy. Total thyroidectomy is indicated in large thyroid carcinomas and also in the smaller papillary adenocarcinoma. Radical neck dissection is warranted if lymph node metastasis is present and limited to the neck; also in the absence of metastasis if the tumor is papillary in histologic pattern. Surgically inaccessible metastatic lesions are best treated by radioactive iodine or external irradiation.

One scintigram; 4 tables.

The Prevention of Peritoneal Tumor Implants by Radioactive Colloidal Gold (Au^{198}). Edward R. Woodward and Paul V. Harper, Jr. Ann. Surg. **140**: 206–211, August 1954.

The authors performed a series of experiments on rats, injecting cell suspensions of Walker sarcoma 256 intraperitoneally. The tumor implants developing on the peritoneal surface produced ascites and death, closely resembling the syndrome often seen in patients with abdominal cancer.

Treatment with radioactive colloidal gold (Au^{198}) immediately after tumor inoculation caused a lengthening of survival time. At the 2-mc. dose level, a significant failure of tumor implantation, as well as prolongation of life, was suggested. Higher doses of radiation seemed to decrease the animals' resistance to the transplantable tumor, which would appear to indicate an optimal dose for the sarcoma. Two to 4 mc. reduced the incidence of ascites in animals dying of sarcoma. A comparable dose, per unit area of peritoneum irradiated, is safe in man (150 mc.), so that application of this method to patients with cancer may have considerable value.

Injection of Au^{198} five weeks before tumor inoculation produced a diminished survival time, indicating that prior irradiation reduced the rat's resistance to peritoneal implantation.

The experimental results seem to justify further exploration of the possibility of curative rather than palliative use of intraperitoneal radioactive colloids. Clinical application of this conclusion is discussed by the authors. Injection of gold as soon as possible after operation is to be preferred. A primary problem is the prevention or resolution of fibrinous adhesions between the various viscera. Intraperitoneal fibrinolysins and heparin may become practical solutions but involve the danger of hemorrhage. A partial solution of the prob-

lem may be achieved by using pneumoperitoneum, the technic of which is described.

Three photographs; 4 tables.

C. M. GREENWALD, M.D.
Cleveland Clinic

Biological Studies on Stable and Radioactive Rare Earth Compounds. III. Distribution of Radioactive Yttrium in Normal and Ascites-Tumor-Bearing Mice, and in Cancer Patients with Serous Effusions. Ruth Lewin, Hiram E. Hart, Joseph Greenberg, Herta Spencer, Kurt G. Stern, and Daniel Laszlo. J. Nat. Cancer Inst. **15**: 131–143, August 1954.

The distribution of radio-yttrium, Y^{90}, following intracavitary administration in ionized form, was studied in normal and Ehrlich ascites-tumor-bearing mice and in terminal cancer patients in order to explore the potentialities of this isotope in the palliative treatment of carcinomatous effusions in man. Radio-yttrium has certain properties which make it suitable for this purpose. It has a half-life of sixty hours and emits only beta rays, which will penetrate tissues to about 10 mm. in depth, and therefore it will cause no damage to distant tissues and presents less safety hazards to the personnel handling it.

The authors' studies showed that the addition of carrier yttrium enhances the localization of intraperitoneally injected Y^{90}. However, the low recovery of Y^{90} from extraperitoneal tissues and its minimal excretion are not sufficient evidence to rule out the transport of sizable quantities of this isotope from the injection site into the general circulation, with subsequent deposition within the intraperitoneal organs, such as liver. At low carrier levels significant amounts of Y^{90} were found in tissues distant from the injected cavity, whereas with relatively high carrier levels, the "leakage" from the cavity was greatly reduced.

The potential usefulness of Y^{90} in palliative therapy of carcinomatous effusions is discussed. The affinity of yttrium for chelating agents, such as EDTA (ethylenediaminetetraacetic acid) would offer an advantage over the isotopes currently employed for this purpose. By analyzing blood levels for Y^{90} activity following its intracavitary injection, one could detect the accidental entry of the radioisotope into the blood stream at an early stage, and its removal could then be effected by the prompt administration of such chelating agents.

An investigation of the properties of preformed radio-yttrium colloids and chemically inert radio-yttrium suspensions of suitable particle size are now in progress. Such preparations may possess certain advantages over ionic radio-yttrium because they afford a closer control of particle size.

Thirteen radioautograms; 5 photomicrographs.

RADIATION EFFECTS; EXPERIMENTAL STUDIES; RADIOBIOLOGY

Unilateral Hypoplasia of the Female Breast Following Radium Therapy of an Hemangioma. W. Rübe. Strahlentherapie **94**: 561–565, August 1954. (In German)

Hypoplasia of a female breast can be caused by relatively small doses of radiation therapy, if given in early childhood. The author reports such a case in a fourteen-year-old girl. At three months of age she was treated with radium for hemangioma of the right breast region, receiving about 1,200 gamma r to the lesion, given in three treatments over a four-week period. The tumor had a diameter of about 10 mm. and was close to the nipple. Fourteen years later there was marked atrophy of the right breast, slight atrophy of the irradiated region with pigmentation, but no telangiectasis. A thorough clinical examination revealed no evidence of any other anomaly, tuberculosis, trauma, or poliomyelitis.

The author cites 4 similar cases from the literature but believes that other causes of unilateral hypoplasia were not adequately ruled out in these cases.

Hemangioma of the breast region is rare. The mammary gland tissue is highly radiosensitive in early childhood and extreme caution in treating such lesions is advised.

Two photographs.

EUGENE F. LUTTERBECK, M.D.
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Leukemia in Atomic Bomb Survivors. II. Observations on Early Phases of Leukemia. William C. Moloney and Robert D. Lange. Blood **9**: 663–685, July 1954.

The incidence of leukemia in atomic bomb survivors is high. Seventy-five cases have been investigated by the Atomic Bomb Casualty Commission. The present report is based on 10 cases discovered in a group of 3,480 individuals being studied as follow-up survivors. Five of the cases were recognized in the preclinical stage. In 3 of these, bone marrow findings were obtained before peripheral blood stream changes occurred. All but one of the patients in the series had received a considerable dose of radiation—200 r or more.

The authors were able to obtain little light on the pathogenesis of acute and subacute leukemia. No significant blood findings preceded the development of clinical evidence of these types of disease. In all but one patient, however, the blood studies were done at least a year prior to discovery of leukemia. These cases were in striking contrast to 3 cases of chronic myelogenous leukemia, in which abnormal blood elements were present eighteen or more months before clinical onset. In the preclinical stage, disturbances in red cells and platelets, as well as leukocytosis with immature neutrophilic granulocytes, were noted. Outstanding was an increase in basophils, many of them atypical. In 2 cases, separated leukocytes of the peripheral blood gave extremely low values for alkaline phosphatase.

The cause of leukemia is still an enigma. Common concepts involve two factors: (1) hereditary capacity for abnormal growth and (2) various physical, chemical, and metabolic agents capable of precipitating or activating leukemogenesis. This suggests possible direct injury to nucleoproteins of the chromosomes or enzyme systems associated with nucleic acid synthesis. The long latent period in bomb survivors, and the early hematologic and biochemical changes, favor irradiation damage of cell enzyme systems, resulting in a gradual loss or alteration of cell growth factors.

Six figures; 9 tables. GEORGE A. SHIPMAN, M.D.
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Batch Processing of Film for Radiation Protection of Personnel. R. J. Magill. Arch. Indust. Hyg. & Occup. Med. **10**: 37–42, July 1954.

Film-badge dosimetry is a convenient method for measuring personnel exposure to x-rays and gamma radiation. Its use has been extended to monitoring other radiation, such as neutrons, both slow and fast.

The accuracy of film dosimetry obviously is highly dependent on controlled conditions of development. The developer must be as chemically exact as possible. If it is used for large areas of film or allowed to stand for protracted periods of time, it must be compensated for exhaustion and oxidation. Agitation is an important factor which is often neglected. In a still tank, there is some interchange of developer from the solution into the film. The exhaustion products tend to flow down the film, and a variation in density may thus be produced between the upper and lower part.

Development of the film badge is usually done with equipment designed for dental x-ray work, since the film sizes are the same, but a system designed for quick inspection during processing and for a steady work load seems to impose an unnecessary burden on the inherent accuracy of processing. Two other systems of handling seem more desirable for densitometric accuracy. In the first or *batch* method, all films for an exposure period are processed at once in a compact, light-tight tank, with holders firmly supporting the film. The second is a continuous system, such as that used for motion-picture film, with the pieces of film carried on a belt; owing to relative cost and the set-up required, it would not seem feasible to use this latter method for less than 1,000 films per exposure period. The various factors influencing development are considered in relation to the three systems of processing just described.

In the author's opinion, batch-processing equipment represents the minimum investment and involves the shortest working time for a work load between 10 and at least 1,000 films per exposure period. The steps in processing are described briefly. Conditions of development are closely controlled because fresh solutions are used for short periods of time and because agitation is performed at the optimum rate. Standard exposures processed with the unknowns make it possible to correct a standard calibration curve for the usual small differences in development and in film speed.

The use of a light-tight tank with a light trap for pouring solution in and out makes more than a dark closet with 3 ft. of bench space and a safelight unnecessary. Even though more elaborate equipment, with a pump for agitation and fluid handling, is used for operations involving 400 films or more, this same darkroom space is adequate. By evaluating film with an optical wedge comparator instead of a densitometer and processing with this simple batch equipment, it is possible to handle as few as 25 films per exposure period at a cost per film comparing favorably with present systems involving several hundred films.

Two illustrations.

Radon Levels Found in Mines in New York State. Saul J. Harris. Arch. Indust. Hyg. & Occup. Med. **10**: 54–60, July 1954.

The purpose of this paper is to present the results of a study of air-borne radiation levels in various underground working places in New York state, including operating mineral mines, an abandoned iron mine, and a sight-seeing cavern. Many of the mines have been worked continuously since the Civil War, and hence the mining population of the district can trace its history through several generations. Any radiation exposure conditions found today would indicate the possibility of past and continued exposure of small groups for several generations.

Filter-paper samples of dust were counted immediately, with use of a Samson Alpha survey meter carried down into the mine. When these instantaneous readings indicated the presence of appreciable quantities of radon daughters, samples of ground water and the ore were collected and later analyzed for the parent, Ra^{226}. Two methods of calculating radon levels from dust samples of daughter products were used. The first consisted of a straightforward conversion from disintegrations per minute per liter to curies per liter, with correction factors for collection efficiency and self-absorption of alpha particles in filter paper. The second calculation used a formula developed by Dr. John Harley for this same purpose. The two calculations agreed reasonably well with each other and in some instances exceptionally well with the concentrations as determined by the direct method. In the majority of the places sampled, radon levels between 10^{-10} and 10^{-11} curies per liter were found.

This investigation reveals that the value in use for maximum permissible concentration of radon and radon daughter products of 10^{-11} curies per liter may be exceeded in underground work areas as a result of the presence of natural radioactive parent material. The concentrations may be of such nature as to present a significant hazard to those exposed. This would appear to be true in any underground work area in any section of the country, regardless of the absence of mineable uranium.

Two figures; 2 tables.

Effects of X-Irradiation on the Hypothalamus: A Possible Explanation for the Therapeutic Benefits Following X-Irradiation of the Hypophysial Region for Pituitary Dysfunction. Arthur Arnold. J. Clin. Endocrinol. & Metab. **14**: 859–868, August 1954.

The purpose of this paper is to suggest a possible explanation for the therapeutic benefits following x-irradiation of the hypophysis for certain disorders attributed to pituitary dysfunction, as malignant exophthalmos, selected cases of hypertension, and various gynecologic conditions, as amenorrhea, oligomenorrhea, sterility, etc. The literature indicates that even though the pituitary body has been labeled radioresistant on the basis of histologic studies, pituitary function may, nevertheless, be altered by irradiation.

The present study is part of a comprehensive investigation to analyze the effect of high-energy x-rays on the central nervous system of the monkey (*Macaca mulatta*) and man. A betatron (23-mev) was the source of the x-rays. Observations were made on 6 monkeys in which the radiation had traversed the entire hypothalamus. (A footnote mentions 5 additional monkeys.) These were selected from a larger series in which the beam was directed through the brains of healthy adult monkeys, transtemporally and transfrontally. Each monkey, while under Nembutal anesthesia, was given its total dose of x-rays in a single exposure. Two different beam sizes were used: (1) a 1.0-cm. beam, with no filter, 83.4 cm. distance, and a dose rate of 150 r per minute; (2) a 2.5-cm. beam, with compensating filter and dose rate of 75 r per minute.

The monkeys were sacrificed at five to six months after irradiation, for histologic study. One monkey received 1,500 r to the hypothalamus (tissue dose). Two received 3,000 r, 2 received 5,000 r and the sixth 7,000 r. A single dose of 3,000 r, equivalent to 1,800 r of 200–400-kv x-rays, produced in one monkey almost selective destruction of the paraventricular and supraoptic nuclei. This effect was observed to a lesser degree in a monkey receiving 1,500 r (equivalent to 900 r of 200–400-kv x-rays). With doses above 3,000 r, the entire hypothalamus is usually seriously damaged and the cortical areas through which radiation passes are affected as well.

The authors suggest that the hypothalamus and in particular the paraventricular and supraoptic nuclei exert considerable influence over the function of the pituitary body. The evidence of the destruction of the nuclei in the experimental situation suggests that these degenerative changes may account for the clinical benefits observed when the hypophyseal region is irradiated for pituitary dysfunction.

Four photomicrographs; 1 graph.

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Intolerance of the Primate Brainstem and Hypothalamus to Conventional and High Energy Radiations. Arthur Arnold, Percival Bailey, and Roger A. Harvey. Neurology **4**: 575–585, August 1954.

The authors have previously reported the intolerance of the brainstem and hypothalamus to large doses of radiation from conventional x-ray apparatus and from the betatron (see Absts. in Radiology **64**: 632, 1955). In this paper they demonstrate the greater responsiveness of these areas to moderate doses, as compared with the cortical areas of the brain, and discuss the clinical significance of their observations.

Experiments on monkeys indicated that with 23-Mev x-rays in doses in excess of 3,000 r (equivalent to 1,800 r of 400-kv x-rays) both the cortical areas and the hypothalamus are damaged, but at lower doses the nuclear masses of hypothalamus show the greater reaction. In man, delayed degenerative changes in the fiber tracts and cellular constituents of the brainstem were found to follow irradiation (4,500 r at 400 kv in thirty days or its equivalent) for tumors in this area.

The reaction of the brainstem to moderate doses of radiation and its intolerance for high doses predicate certain considerations of practical importance in tumor therapy. In patients with highly malignant lesions of the brainstem and hypothalamus, temporary palliation may be obtained with doses of 4,000 to 5,000 r and, since these patients seldom survive for more than a few months, the possibility of a delayed radionecrosis may be disregarded. On the other hand, it appears inadvisable to give large doses of radiation to slowly growing tumors in this area, since death may be hastened thereby. In such benign lesions as ependymomas and astrocytomas, small doses of radiation (a tumor dose of less than 3,000 r in four weeks) following surgical decompression and relief of obstruction may afford some inhibition of tumor growth without attendant radionecrosis of the brainstem.

Applying their observations to the field of atomic radiation, the authors suggest, on theoretical grounds, that doses of gamma and neutron radiation from an atomic blast biologically equivalent to 1,500 r of 23-Mev x-rays could conceivably affect the brainstem of man seriously provided the brunt of the exposure were borne by the head, and the body were partially shielded.

It is further suggested that some of the benefits obtained from irradiating the pituitary for disorders related to dysfunction of that gland may be due to effects on the hypothalamic nuclei, which in turn exert a considerable control over the pituitary and its many functions.

Eight illustrations.

Effect of Multiple Low-Dose Irradiation and Splenectomy on the Stability of Dog Erythrocytes. Marguerite A. Constant and Paul H. Phillips. Am. J. Physiol. **178**: 367–370, August 1954.

A study was made of the erythrocyte fragility of splenectomized and non-splenectomized dogs receiving 100 r whole-body x-irradiation per week until death, and the findings were compared to those in normal animals. The erythrocytes of the splenectomized animals showed a marked decrease in fragility in comparison to those of normal non-irradiated dogs. The erythrocytes in non-splenectomized dogs also were less fragile, but the change was not as great and occurred later than in the splenectomized animals. The time at which the decreased fragility occurred varied from animal to animal, and was not evident in one non-splenectomized dog until two weeks prior to death. A rise in erythrocyte fragility was observed in several dogs in terminal stages of radiation sickness.

No correlations were apparent between the degree of erythrocyte fragility and life expectancy, hemoglobin levels, platelet counts, or target cell counts. Splenectomy did not decrease life expectancy.

Ten graphs; 1 table.

Changes in the Phagocytic Activity of Polymorphonuclear Leukocytes Following Total Body X-Irradiation in the Rat. M. Wilkinson. Blood **9**: 810–816, August 1954.

X-irradiation in sufficient dosage has been shown to result in a decrease in the number of circulating leukocytes, with a temporary increase in the phagocytic index, probably due to the greater number of bacteria available to each phagocyte, followed by a decrease in phagocytic activity.

The investigation reported here was planned to determine the effect of irradiation on the function of those few leukocytes which continue to be formed and delivered to the blood stream. Parallel phagocytic studies were performed on suspensions of normal leukocytes in plasma from irradiated rats, on leukocytes from irradiated animals, suspended in normal plasma, on blood from normal rats, and on blood from irradiated rats.

Leukocytes from irradiated rats (550 r total-body irradiation) showed increased phagocytosis of plague bacilli during the first six days after irradiation, but on statistical analysis this increase proved to be insignificant. From the seventh to the thirteenth day these cells showed a markedly reduced capacity to phagocytose the bacilli. Though there was a suggestion of a defect in the plasma of the irradiated animals, the study showed the deficient phagocytosis during the second week to be due to a defect in the polymorphonuclear leukocytes themselves.

Presumably, those primitive leukopoietic cells in the bone marrow which escape destruction by irradiation

are not undamaged and give rise to a generation of functionally deficient leukocytes which appear in the peripheral blood during the second week following exposure.

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Palo Alto, Calif.

An Abscopal Effect of X-Ray upon Mouse Spleen Weight. Antolin Raventos. Radiation Research 1: 381–387, August 1954.

The experiments described here were designed to distinguish between splenic weight changes resulting from the action of x-rays on the spleen itself and those arising in response to radiation effects elsewhere in the body. The basic plan was to irradiate the surgically mobilized spleens of a pair of littermate mice simultaneously, and under identical conditions, except that one member of the pair also received the x-ray dose over the entire body and the other member's body was shielded. Spleen weights were determined on the fifth post-irradiation day. Any consistent difference between the shielded and the exposed members of the pairs must then be due to irradiation of tissue other than the spleen, since the spleen x-ray dose was the same for both members of the pair.

Since the exteriorization procedure used was itself found to have a marked influence on spleen weight, the results obtained apply only to exteriorized spleens and do not necessarily reflect the phenomena that follow irradiation of non-exteriorized spleens.

Irradiation of the spleen alone resulted in spleen weights independent of x-ray dosage over the range 300 to 750 r. Irradiation of the spleen plus the remainder of the body resulted in spleen weight losses showing a marked dependence on x-ray dosage. It was assumed that no significant recovery of spleen weight occurs in five days. It is concluded that irradiation of the remainder of the body probably provokes splenic atrophy, perhaps through adrenal cortical action. Irradiation of the body did not produce spleen weight loss when the spleen was shielded, and it is suggested that the shielded spleen is able to respond to the hematopoietic needs of the irradiated animal.

One photograph; 1 graph; 1 table.

Granulocyte Count, Resistance to Experimental Infection and Spleen Homogenate Treatment in Irradiated Mice. Willie W. Smith, Robert Q. Marston, H. Jeanette Ruth, and Jerome Cornfield. Am. J. Physiol. 178: 288–292, August 1954.

An investigation was made (1) of the leukocyte count in irradiated mice injected subcutaneously with *Pseudomonas aeruginosa* as a "challenging" agent, (2) of the effect of granulocytes and lymphocytes on the resistance to infection, and (3) of the influence of treatment with spleen homogenates.

Four experiments were conducted. In groups 1a, 2a, and 3a, receiving a radiation dose of 475 r (LD 5), leukocyte counts followed by *Pseudomonas* inoculation were made five to nineteen days after irradiation. Parallel groups, 1b and 2b, were injected intravenously with spleen homogenate and challenged on the same days as groups 1a or 2a. In group 3b the animals were given a higher radiation dose (still essentially sublethal because of the homogenate injection) and were challenged after intervals calculated to correspond to that part of the leukocyte recovery phase covered in the non-homogenate series, 3a. In the last experiment the number of organisms inoculated was substantially reduced to give some survival with challenge on the seventh day after 625 r (LD 80, mean time to death 13.9 days).

The survival of the mice in the above experiments was found to be associated with the leukocyte count as recovery from the damaging effects of irradiation progressed, whether at a normal rate or accelerated by spleen homogenate. An association of the same magnitude was observed among mice of each treatment group (but with naturally varying counts). This association was shown to depend upon the granulocyte count, with no measurable lymphocyte contribution.

Four graphs; 3 tables.

Effects of Cortisone on the Development of Spontaneous Leukemia in Mice and on Its Induction by Irradiation. A. C. Upton and J. Furth. Blood 9: 686–695, July 1954.

The authors were able to inhibit development of spontaneous lymphoma in mice by administration of cortisone, although hormone-induced atrophy of thymus and lymphoid tissue was only transient. This result was obtained with as little as three successive daily injections of cortisone, but it was more certain after three months continuous administration.

A high incidence of myeloid leukemia was induced in a low-leukemia strain of mice by irradiation. Its frequency was not affected by cortisone in males, but in females administration of cortisone prior to irradiation appeared to have some inhibiting effect.

In male mice irradiated before cortisone administration there was increased incidence of radiation-induced lymphoma, while in animals irradiated after receiving cortisone the incidence was decreased.

Six photomicrographs; 13 graphs; 1 table.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Mutation in Drosophila melanogaster Males Exposed to β-Radiation from Neutron-Activated Phosphorus-Bakelite Plaques. R. C. King. Radiation Research 1: 369–380, August 1954.

The author here re-examines the problem of the mutagenic efficiency of beta radiation on the fruit fly, *Drosophila melanogaster*. The radiation sources were neutron-activated red phosphorus-Bakelite plaques. Sperm of two- to four-day-old male fruit flies irradiated with doses of 2,000 or 4,000 r were tested for sex-linked recessive mutations by a modification of Muller's "Binscy" method.

The x-ray-induced recessive lethal mutation rate in *Drosophila melanogaster* was found to be the same whether or not X chromosomes are modified by the attachment of fragments of the Y chromosome.

Beta rays from the neutron-activated, phosphorus-Bakelite plaques were shown to be 60 per cent as efficient as 90-kv x-rays in producing sex-linked recessive lethal mutations. This difference is attributed to differences in the distribution of ionization produced in tissue by the two classes of radiation. Recalculation of earlier data leads to the conclusion that the experimental and calculated values for the fraction of the total P^{32} beta-particle energy absorbed by the gonad of P^{32}-labeled *Drosophila* males are not in disagreement, as was previously thought (King: J. Exper. Zool. 122: 541, 1953).

Symposium: Some Biological Effects of Radiation from Nuclear Detonations. Introduction. Harold H. Plough. Am. Naturalist **88**: 209–213, July–August 1954.

Radiobiological Studies with Tradescantia at Nuclear Test Detonations. Alan D. Conger. Ibid., pp. 215–224.

The Theory and Application of a New Method of Detecting Chromosomal Rearrangements in Drosophila melanogaster. E. B. Lewis. Ibid., pp. 225–239.

Visible and Lethal Mutations in Drosophila. George H. Mickey. Ibid., pp. 241–255.

The Effect of Neutrons on Thymic and Circulating Lymphocytes in the Mouse. Robert E. Carter, Eugene P. Cronkite, and Victor P. Bond. Ibid., pp. 257–267.

The Relative Effectiveness of Neutrons from a Nuclear Detonation and from a Cyclotron in Inducing Dominant Lethals in the Mouse. W. L. Russell, Liane B. Russell, and A. W. Kimball. Ibid., pp. 269–286.

The Production of Translocations in Drosophila virilis by Fast Neutrons from a Nuclear Detonation. Wilson S. Stone, Mary L. Alexander, Frances E. Clayton, and Edna Dudgeon. Ibid., pp. 287–293.

Survival and Mutation in Neurospora Exposed at Nuclear Detonations. K. C. Atwood and Frank Mukai. Ibid., pp. 295–314.

The papers listed above constituted a Symposium held at a joint session of the American Society of Naturalists and the Genetics Society of America, Dec. 28, 1953, designed to acquaint biologists with some of the effects of radiations from nuclear detonations on biological material exposed in field tests in 1953.

Conger reported experiments in which the flowering plant *Tradescantia* was exposed to radiation from nuclear test devices under different conditions, the object being to estimate the dose delivered on the basis of chromosomal breakage and to compare this estimate with physical measurements made simultaneously, as with calibrated film packs and ionization chambers. One experiment was carried out in airplanes flown through atomic clouds at different altitudes; in another, exposures were made to gamma radiation at various distances along the ground from the nuclear test device; in others, exposure was to fast neutrons.

No new or novel effects of the irradiation were observed. In the airplane and gamma-ray experiments, the correspondence of the biological effects (chromosomal aberrations) and physical measurements was such as to indicate that physical instruments will furnish accurate measurements of biological dose. It was further shown that neither the test gamma rays, or neutrons, at least over the considerable biological range of doses studied, have a relative biological effectiveness which differs significantly from that known from laboratory sources of these radiations. Under rather difficult conditions *Tradescantia* can be said to have functioned as a dosimeter with an average accuracy of 10 to 15 per cent.

Lewis used a new method, which he calls the "biothorax method," for detecting chromosomal rearrangements in *Drosophila melanogaster* exposed to x-rays and to fast neutrons and gamma rays. His paper is devoted chiefly to the theory and application of the procedure, with only brief mention of the results. The significant feature of the method is a new type of position effect called the "transvection effect," which involves several unique features. By this means, fast (pile) neutrons were found to be more effective than x-rays or gamma rays in producing chromosomal rearrangements in *Drosophila*. Estimates of the dose of fast neutrons at different stations during a nuclear detonation by the biothorax method were found to be in good agreement with physical measurements.

Mickey found, contrary to the observations of many workers, that fast neutrons are at least twice as effective as x-rays and have a much higher relative biological effectiveness for genetic effects in *Drosophila*. This conclusion is based on observations on recessive visible mutations at specific loci on the third chromosome, dominant visible mutations both autosomal and sex-linked, dominant Minute effects, and recessive sex-linked lethal mutations.

Carter, Cronkite, and Bond exposed mice to a portion of the neutron radiation from nuclear devices and compared thymus weight and the number of circulating lymphocytes with those observed in roentgen-irradiated controls and in an earlier series reported by Harris and Brennan, in which a different neutron source was used. On the basis of thymic weight loss, neutron irradiation was found to be 7.4 times more effective than roentgen irradiation in one experiment and 8.1 more effective in another, in which somewhat different roentgen factors were used. The decrease in the absolute lymphocyte count with neutron exposure was 3.9 greater than following x-irradiation. Comparison of the ratios of biological effectiveness as measured by thymic weight loss with those reported by Harris and Brennan for thermal neutrons indicated that a 1.6 fold increase in proton specific ionization was accompanied by no more than a fourfold increase in biological effect. The neutron radiation employed was less effective in decreasing the lymphocyte count in the peripheral blood than it was in producing thymic weight loss, indicating that ratios for neutron effectiveness can differ for similar tissues in the small mammal as well as in lower organisms used in previous experiments.

The Russells and Kimball studied dominant lethality in the offspring of male mice enclosed in lead hemispheres in an effort to discover whether or not the high intensity and the energy spectra of the neutron radiation from a nuclear detonation would show a biological effectiveness significantly different from that observed in an earlier experiment with neutrons from a cyclotron. (Russell *et al.*: Genetics **38**: 688, 1953). No evidence was obtained which would indicate a significant difference either qualitatively or quantitatively in the effects of neutrons in the detonation and cyclotron experiments as measured by dominant lethality. For comparable levels of total effect, the two sets of results did not differ significantly in the distribution of deaths according to age of embryos. The increase in dominant lethality observed when the offspring of late matings were compared with those of early matings was similar in the two experiments. The biological effectiveness of detonation neutrons relative to cyclotron neutrons was found to be between 0.80 and 1.18, the minimum and maximum estimates obtained when allowance was made for uncertainty in the physical measurements of the gamma radiation contamination in the detonation experiment. (Taking the biological effectiveness of cyclotron neutrons relative to x-rays as 8.0, the corresponding minimum and maximum estimates of the biological effectiveness of detonation neutrons relative to x-rays are 6.4 and 9.4, respectively.)

Stone and his associates found fast neutrons to be much more effective than x-rays in producing genetic damage measured as translocations in *Drosophila*

virilis. This difference was more marked at lower doses. With the figures of Baker (Genetics **34**: 167, 1949) for x-ray damage for comparison, the equivalence in damage was roughly estimated as 100 rep and 750 r, 500 rep and 2,000 r, 1,300 rep and 4,000 r. The direct proportionality between fast neutron dosage and translocation frequency indicates that small doses of neutrons are relatively more dangerous to genetic systems than small doses of x-rays.

Atwood and Mukai used conidia of the fungus *Neurospora* for their studies, measuring the effects of nuclear irradiation on the basis of the following observations: first, the survival of conidia under conditions of forced heterokaryosis, where the viability of two or more genetically different nuclei per cell is a prerequisite of survival; second, the survival on supplemented medium, where survivors need contain but a single viable nucleus per cell; and third, the frequency of nuclei carrying recessive lethal mutations.

Despite the opportunities for error, the findings on *Neurospora* conidia, taken as a whole, strongly indicate that the effects of radiation from the nuclear devices are similar in all respects to those which can be produced in the laboratory.

RADIOPHYSICS; RADIOCHEMISTRY

Optimum Shape for Cylindrical Ionization Chambers. R. K. Clark and S. S. Brar. Nucleonics **12**: 28–29, August 1954.

The ionization collected in an ionization chamber is generally assumed to be located at a distance from the source determined by the center of the ionization chamber. When the dimensions of the chamber are not sufficiently small compared with the distance of the chamber from the source, a correction is necessary on a purely geometrical basis. For the special case where absorption and scattering can be neglected, this report develops the necessary correction as a function of ionization chamber dimensions and distance from the source.

Two figures.

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A Molecular Product Dosimeter for Ionizing Radiations. Edwin J. Hart and P. D. Walsh. Radiation Research **1**: 342–346, August 1954.

A system for determining the combined free radical and molecular product yields of ionizing radiations in aqueous solution is described which departs significantly from the ferrous sulfate dosimeter in current use. The new system employs a blend of ferrous and cupric sulfates in sulfuric acid, and the net reaction observed is only that due to hydrogen peroxide formed in the "hot spot" or along the particle track. Comparative observations with the two dosimeters are presented.

Two graphs.

The Distribution of Linear Energy Transfer or "Ion Density" for Fast Neutrons in Water. John W. Boag. Radiation Research **1**: 323–341, August 1954.

The term linear energy transfer (LET) has been proposed for the rate of energy loss of an ionizing particle. The author here examines the distribution of LET values for the recoil nuclei produced when fast neutrons bombard water. Since no two experimental situations are exactly similar, a comprehensive calculation is impossible and several different situations are considered instead.

The geometry and other irradiation conditions normally encountered may be bracketed between two extremes. On the one hand, the relevant dimensions of irradiated material may be small compared with the mean free path of the neutrons in it. On the other hand, the dimensions may be large in comparison with the free neutron path. In practical cases the irradiated object is often of a size comparable with the mean free path of the neutrons in it, in which event it is reasonable to assume that the LET distribution will lie between the two extremes.

The energy and track length distributions for a mixed energy neutron beam are shown to be closely similar in the two extreme cases of single collisions and infinite medium. This is due to the three successive degradation or averaging processes: (1) over the neutron energy spectrum; (2) over the proton recoil energy distribution; (3) along the tracks of the recoil protons. The final LET distribution is therefore rather insensitive both to the precise form of the primary neutron energy spectrum and to the size of the irradiated material. Practical cases are thus closely bracketed by the two extremes which have been considered.

Studies on the Chemical Nature of the Radiation Protection Factor in Mouse Spleen. I. Enzymatic Inactivation by Deoxyribonuclease and Trypsin. Leonard J. Cole and Marie E. Ellis. Radiation Research **1**: 347–357, August 1954.

It has been previously shown that the ability of mouse spleen homogenates to protect against radiation death when injected into otherwise lethally irradiated mice is associated with the nuclear fraction. It has been proposed that the protective factor may be a nucleoprotein. Experiments were undertaken to test this hypothesis and to obtain further data on the chemical nature of the factor. Crystalline enzymes were employed as specific analytical reagents.

A group of 30 to 40 adult LAF_1 mice was exposed to a single dose of roentgen radiation, usually 750 r, which is 100 per cent lethal to untreated or buffer-injected mice of this strain. Enzyme-incubated spleen homogenates and corresponding spleen homogenates to which no enzyme had been added were injected intraperitoneally into one of two groups respectively of the irradiated animals two hours after irradiation. A third group was injected with phosphate buffer, thus serving as irradiated buffer controls. Analogous experiments involving the spleen nuclei fraction were also carried out.

Deoxyribonuclease and trypsin were found to inactivate the protective factor in mouse spleen but it was resistant to the enzymatic action of ribonuclease.

The data obtained in these experiments appear to provide experimental support for two general conclusions as to the nature of the radiation protection factor in mouse spleen; (1) that it is a non-cellular factor and (2) that chemically the factor is a deoxyribonucleoprotein (or a substance whose biological activity depends on the structural integrity of the deoxyribonucleoprotein).

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